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(Established 1878)

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CONTENTS.

Shop Passage-Ways

The routing of materials is given considerable attention in the layout of the machine tools for a shop; that is, the machines are placed so that work may travel the least distance during its progress to the various machines. However well the machine tool layout may have been devised when the shop was new, its efficiency will necessarily be decreased after a few years. The need of larger space for the storage of castings may decrease the size of a passage-way or may blockade a door. A new machine placed near a stairway may prevent materials being carried past it. Conditions are changing constantly and the average shop superintendent may often be able to make beneficial changes if he will take time to note the conditions, as do the efficiency men.

If there is congestion and occasionally a blockade caused by material passing down an aisle, something is wrong with the routing of materials and the location of machine tools. Perhaps a new passage-way can be opened and some of the work can take a different course. It is hard to keep the passage-way through the center of the shop clear, for on occasion it is impossible not to encroach on this space, especially if it is not marked. Some shops have painted a white strip along either side, thus marking the aisle and it is a very good thing if the rule against encroaching on them is enforced.

Often a number of machines will be seen in a shop so placed that a pocket is formed, making it difficult to get material in or out, and it becomes a dumping place for rubbish. Thus good floor space is wasted, bringing absolutely no return on the investment. Or, for instance, a countershaft is placed on the floor and a horizontal belt is used to transmit power to the machine. Such cases are not frequent, especially in these days of individual motor drive, but it illustrates how free movement may be hindered and good floor space wasted. The increasing use of motor drive is making it much easier to move a machine if it becomes necessary as there is no need of considering the line shaft.

We do not advocate that extreme refinement where the time spent in so doing overtops the practical benefits, but we do think that if the men in charge of our shops would take a day every six months to go through the plant with a view of looking about for places where space is being wasted and where aisles are congested, that the result would be as good and much cheaper than turning an efficiency engineer loose in the shop.

The Roundhouse and Back Shop

An efficient and well equipped roundhouse and back shop can do much towards decreasing the time during which a locomotive is out of service, and while the roundhouse has not been given the attention it has deserved in the past, recent constructions along these lines indicate that more care is being taken with regard to its design and equipment.

Equipment of course should be in proportion to the size and importance of the terminal. Most of the houses now being built, however, are equipped with drop pits, ventilating systems, electric power outlet, boiler washing systems, good lighting systems and some are being equipped with traveling cranes.

Good light, heat, and ventilation are important factors in facilitating roundhouse repairs, for in order to get good results from the roundhouse men conditions must at least be equal to those at repair shops. Many of the newer roundhouses are also equipped

with lockers and adequate toilet facilities, all of which help to get the best out of the meu.

Washing systems effect a great saving of energy and time, as well as protecting the boiler against leaky flues. Wall plugs for the connecting in of electrically operated tools are greatly to be desired if electric power is available.

As the roundhouse and back shop are very closely in touch with actual operating conditions and can receive reports concerning defects and repairs at first hand from the engine men, it is essential that they be in the hands of capable workmen and be supplied with the facilities and tools for making light repairs. Frequently the back shop is equipped with insufficient tools and ofttimes these tools are old ones which the repair shop has thrown out.

There are instances where back shops are equipped entirely with old tools thrown out of the repair shop. This is a rather short-sighted policy. The tools of the back shop should be the very best and should be so complete as to enable all light repairs to be handled without trouble. It means a considerable loss of time, and therefore earning power, to take an engine to the repair shop, and if a day can be saved by making the repair at the terminal, it will make quite a saving.

The roundhouse and rouudhouse foreman have been the subject of much abuse and it is time that more atteution be paid to this connecting link between the mechanical and operating departments. It is a ''first-aid-to-the-injured'' station and its facilities should be adequate.

C. M. & St. P. Electrification

The Chicago, Milwaukee & St. Paul has under way au electrification project which will eventually cover four engine divisions or a distance of about 440 miles, and it is one of the most comprehensive projects of this sort which has been undertaken by any transcontinental line. It is also said that should the results prove satisfactory, the work will be extended to the coast, a distance of 850 miles.

This electrification is very significant as it marks the first extensive use of the water powers of the West for trunk line electric operation. The road referred to passes through a district abundantly supplied with developed and undeveloped power and the railway is able to purchase it for a trifle over a half cent per kilowatt hour. It is expected, therefore, that a reduction in the present cost of steam operation will be effected and that a good percentage will be returned on the investment. With the abundant supply of accessible power the chances seem bright for the attainment of this eud.

The success of this project will undoubtedly have considerable influence on future developments of this nature, for there are a number of roads which, through their locations, may be able to follow the example of the Milwaukee road and the next few years may see numerous developments of this sort. It is to be hoped, however, that the public will not sieze upou these projects as examples of the success and economic value of electrification in order to force the railroads to electrify in localities where power canuot be produced at the low figure obtainable in districts well supplied with water power.

One of the interesting features of the Chicago, Milwaukee & St. Paul electrification project is the use of direct current at the high potential of 3,000 volts. The adoption of this voltage was due in a large measure to the success of the operation of 2,400 volt direct current installation of the Butte, Anaconda & Pacific in the immediate territory. A comparison of steam and electric operation on the latter road showed a total net saving of over 20 per cent on the investment, together with other advantages from an operating standpoint.

The locomotives for use on this latest electrification project have a continuous rating of 3,000 horsepower, weigh complete about 260 tons and are the most powerful yet constructed. In addition to the regular air brake equipment, they are designed to permit electric braking, something which has not been done heretofore on motors of the size involved. The working and results of this project will be watched with much interest by the railway world.

THE PRESENT DUTY OF THE RAILROADS.

The railroads of this country for several years past have been conducting a propaganda of education before the general public to establish the merit and justice of their plea for higher freight rates. The final success crowning these efforts is represented in the recent decision of the Interstate Commerce Commission granting the 5 per cent increase to railroads in Central classification territory. Now the western roads are presenting their case and appear likely to be accorded similar treatment by the national commission. It is not overstating the facts to set forth positively that public sentiment in favor of the railroad's position has brought about the recent important ruling in terms largely to the advantage of these interests.

Why has the public been swung around to support the railroads in their fight for greater revenues, when the tendency of the times only a few years back was all in the direction of hedging about the transportation companies with increasing restrictive and regulative legislation and of forcing them to put their affairs upon a more economical and efficient basis?

The answer is clear. The public has been convinced by the railroad's own words spoken in support of their case that the prosperity of the whole country inextricably is related to the prosperity of the railroads, and that without the latter there can be no general condition of good business.

The situation that now arises, therefore, imposes immeasurable responsibility upon the railroads. The soundness of their recent contention that the business public owes much of its well-being to their maintenance upon a safe financial foundation remains to be proved, however popularly acceptable it may now appear to be. It rests with the railroads of the United States to make a faithful effort to keep faith with the general public and to do everything in their power to bring about the return of good business which the country impatiently has been awaiting several years.

No one expects or desires the railroads to buy what they do not need or cannot use. To do so would be poor business. On the other hand, it is too much for the railroads to expect they can wait until their earnings reach the point where they can afford to buy without much restrain before they decide to release orders worthy to be called such. If they do, they probably will have little reason ever to buy on a large scale. To no class of business is it more important to stimulate industry than to the railroads themselves. Only by increased freight tonnage can their revenues appreciably expand. Whatever they do to arouse the now depressed iron and steel trade they will reap richly in the tonnage of raw material or finished product which they will be called upon to carry. The situation, therefore, plainly calls for reciprocal action.

To a certain degree the railroads can buy now and they ought to buy. They owe it first to themselves, but in the larger view they have a duty of faith to discharge with the general public which has supported them in their plea for help. It is apparent some high railroad officials appreciate the trust that rests upon them. They are releasing whatever purchases they prudently can. What the business situation of this country needs at this stage is a more general adoption of this policy.—*The Daily Iron Trade.*

Twenty Years Ago This Month

A review of the year 1894 showed that receivers had been appointed for 38 railway companies, having 7,025 miles of road. Most of these roads were located in the west and south.

Work was progressing steadily on the electric locomotives for the Baltimore & Ohio, to be used in the Baltimore tunnel. They were being built by the General Electric Co. and weighed in their completed state 95 tons. Their maximum speed was 50 miles per hour, which was reduced to 15 miles per hour under full draw-bar pull.

J. P. McCuen, master mechanic of the Alabama Great Southern at Birmingham, Ala., was appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific at Ludlow, Ky.

The Western Railway Club held its January meeting in the smoking room of the Auditorium hotel. A paper on "Methods of Obtaining Economy in the Use of Fuel on Locomotives" was presented by S. P. Bush, superintendent of motive power of the Pennsylvania Lines West, and F. A. Delauo, of the Chicago, Burlington & Quincy, presented a paper on English railway practice. In his paper Mr. Bush said: "The present question relates to the efficiency of the men who handle the coal and the engine." He urged the keeping of a record of each man's work, the establishment of fair standards of what should be done, the offering of inducements and the posting of monthly reports. Among those who took part in the discussion were Messrs. Barr (C., M. & St. P.), Lyon (C. G. W.), Rhodes (C., B. & Q.), Peck (C. & W. I.), Manchester (C., M. & St. P.), Herr (C. & N. W.), and MacKenzie (N. Y., C. & St. L.).

F. Slater, geueral foreman of the Milwaukee, Lake Shore & Western at Kaukauna, Wis., was appointed general foreman of the West Chicago shops of the Chicago & North Western.

The Chicago Pneumatic Tool Co., of Chicago, was incorporated with $50,000 capital stock by J. W. Duntley, James L. Clark and Charles B. Williams.

A committee consisting of Messrs. Sanderson, Pomeroy, Gentry and Gibbs presented a report to the Southern and Southwestern Railway Club on the counterbalancing of locomotives. The report was a long and exhaustive one.

The Southern California Railway, the western end of the Atchison, Topeka & Santa Fe was using oil on a passenger locomotive, having used it in freight service for some time. The burning apparatus was put in under the supervision of William Booth, who had just received a patent on his burner.

Mr. Garstang, superintendent of motive power, and Mr. Laws, mechanical engineer, of the Big Four, devised an apparatus for testing tail lamps. It consisted of a box having a small turntable on the bottom upon which the lamp was placed. A fan connected by a 12-inch pipe entered the box at one side and provided the blast, the lamp being rotated as desired.

The Atlantic Coast Line received some new engiues which were classed 10-32-C. They were 10-wheel engines, with four drivers, a 4-wheel leading truck and a pair of trailers.

The Yale & Towne Mfg. Co. transferred the entire business of its crane department to the Brown Hoisting & Conveying Machine Co., of Cleveland, O. The transfer allowed the Yale & Towne Mfg. Co. to develop its line of pulley blocks, hoists, etc.

A correspondent said: "Will our car departments be abolished, simply remaining a small factor in the mechanical department? This seems to be the tendency of our present system, and to this is due the fact that we are no longer educating men to assume the responsibilities of master car builder." He further stated that it is a fact that the man at the head of the car department seldom becomes the head of the two departments. However the master car builder and the car department are still very much alive after twenty years.

The American Railway Master Mechanics' Association appointed a committee to report on gauges for wire and sheet metal. The confusion of gauges was so great that everyone felt that something should be done.

REPAIRING OF FOREIGN CARS.

By W. P. Elliott, Fmn. Car Dept., Wiggins Ferry Co., St. Louis, Mo.

In March, 1913, issue of the *Railway Master Mechanic* I contributed an article on the subject of bad order, home-empty cars and their final disposition as to repairs. At that time I advocated the establishment of large central repair shops at the various large interchange points to take care of such cars. The M. C. B. rules effective October 1, 1914, require the handling line to give the same care to foreign cars when on its line as it does to its own cars, which in my opinion makes the establishment of central repair shops a vital necessity. As is well known, economy will not permit the installation of the necessary facilities at a great many points on lines of railroads to handle all classes of repairs. This is especially true at large terminals, and the problem of handling foreign equipment that is in a general worn-out condition is usually a serious one. Rule 120 is an excellent one, wherein it requires that cars must either be repaired or destroyed, subject to the discretion of the owner. The Master Car Builders had in mind when framing Rule 120 either the repairing or the destruction of these cars, and if the rule is lived up to, in connection with Rule 1, we will undoubtedly in the course of the next few years see a wonderful improvement in freight car equipment. The question of the handling of these cars naturally falls to a great extent upon the various terminals, where we are the least prepared for it. If central repair shops having the facilities for the handling of all classes of repairs to both wood and steel cars were in operation, the line having in its possession cars which it did not feel in a position to repair could forward them to these shops, where they could be repaired and returned to service in a very short time, thus doing away with a deal of unnecessary switching and useless correspondence, which would be a great relief to the various railroads, allowing them more time for attention to their own equipment. It would probably be impracticable for all roads entering a terminal to attempt to establish shops with the necessary facilities for handling repairs of all descriptions, for the reasou that they as a rule confine themselves as much as possible to the repairing of their own cars, for which the material is usually received from their shops ready to be applied.

The steel car is another very important consideration, and one that will have to be dealt with in the near future, and the facilities required to make that class of repairs are not, as a rule, found at very many points on any railroad. This class of repairs could be taken care of at this shop with the least possible expense, as they would also have the facilities for steel car work. The material and parts necessary for the repairs to various foreign cars can usually be made with a few small exceptions at a shop with the proper facilities, and if the proposition is gone into deeply enough and the co-operation of the various railroads received, a great many articles, for which cars are now held to be procured from the car owner, will allow substitutions which will in no way impair the strength of or destroy the standard to the car. For instance, in several different cases lately I have found it necessary to order five different outside metal roofs from the car owner, and when the roofs were received they were all exactly the same type of roof. By that you see how practical it would be for a shop handling foreign equipment and having the confidence of the car owner, to carry in stock types of roofs especially that would meet many conditions. The same applies to material for steel car repairs, as practically all of the material necessary can be procured from the open market, and a great deal of it, such as channels, sheet iron, etc., can easily be worked into the various forms carried in stock.

The necessity of holding foreign cars for material to be forwarded by the car owner will undoubtedly in the next few years be reduced to a minimum, as the Master Car Builders are making every effort possible to arrive at standards, and I am satisfied that in the course of a very short time the official in charge of a shop of that kind, through the good offices of the Master Car Builders, and his experience with the various cars and car owners, will be in

a position to repair practically any car without conferring with the owner in regard to material and in most cases could follow the original construction without the aid of blue prints. Companies desiring to make betterments in equipment could have on file in the offices blue prints which could readily be referred to when their cars are undergoing repairs.

A shop of this kind should by all means be operated under the jurisdiction of the railroads entering the terminals, in practically the same manner as the interchange bureaus are handled at the present time. I can see no good reason why there should be any obstacle which would in any way interfere with its smooth-working under any conditions. The per-diem could be taken care of in accordance with the Master Car Builders' rules with reference to bad order cars, and cars could be considered as being on the line of the company who forwarded the car to this shop. There are a number of ways in which the expense could be prorated, in fact, it seems to me as a car foreman that it is our only means from an economical standpoint to get these cars repaired.

I read some time ago in these columns an article by E. P. Ripley, president of the Atchison, Topeka & Santa Fe, relative to a standard car. Mr. Ripley has undoubtedly struck a note that means harmony to every car department official in the country, if we would just stop and think what a standard car would mean to the railroads of today. We realize that the railroads carry in stock millions of dollars' worth of material just to meet conditions of a non-standard car. Handling lines are paying the penalty daily for the poor construction of some equipment due undoubtedly to inferior design. Cars, both loaded and empty, are being delayed for material that it would be impracticable to carry in stock. The new safety appliance laws with their increased appliances requiring certain specified locations make it practically impossible to carry stock to meet the conditions made necessary by the handling of foreign cars. This gentleman certainly does voice the opinion of every thinking car man at least, when making his plea for the standard car, but when the time does arrive when we will begin working on the standard car, great care should be taken to see that we are getting the best, and not always thinking of the first cost. We must also take into consideration that the best roof that could be made if applied to a car without proper bracing would give no better service than the poorest roof made. We must also take into consideration that the best draft gear would show failures if applied to an inferior underframe. The selection of the draft gear to meet the conditions of standards will surely be very interesting, as the car men throughout the country seem to be divided as to the spring and friction draft gear. I don't mind saying that I personally favor a certain type of spring draft gear, and I have had some very interesting experiences and have some very positive facts to substantiate my opinion.

I was also interested in an article entitled "The Interchange of Freight Cars," published in the November issue. I note one part which refers to the respective agents having a good general knowledge of a car and the M. C. B. rules. It has been my experience in my eleven years of service in the car department that I have still a great deal to learn with regard to the fitness of a car as to service, loading, etc., and undoubtedly I will keep on learning as new conditions make new demands on my ambition. I can't help feeling that one of the conditions that has kept us away from a standard car is that we have had too many people who have felt that they have known a great deal about the car business, when in reality they knew very little.

The sooner we and the country in general realize that the car department makes up one of the largest industries in our great and prosperous country, handling millions of dollars of the railroads' money each and every year, and that impractical car men will cause the unnecessary expenditure of millions more, the sooner the car business will get on its proper basis. I also noted one part of the article relating to the "Get Even" spirit which the writer claimed existed among car foremen in the handling of M. C. B. defect cards. I am glad to say that we do not have this feeling in the St. Louis terminals, where the Twentieth Century inspection has been in vogue for some eight years past. I am also glad to note that car department representatives throughout the country are forming organizations and are becoming members of some of the very valuable organizations now in existence. This will have a tendency to promote a better understanding of, and uniformity in, working under M. C. B. rules and will afford opportunities for the exchanging of very valuable ideas. It will also create closer acquaintance and will serve to broaden out the minds of any who may take a narrow-minded or selfish view of the M. C. B. rules.

A SHOP ACCOUNTING ASSOCIATION

By J. D. MacAlpine

The question has been asked whether it would be advantageous to have a uniform system of railway shop accounting, the object being, I presume, to afford comparisons that would result in improved methods and reductions in the expense of compiling the various reports.

So far as reducing the cost of compilation is concerned, I think it is probable that at present most offices have eliminated lost motion wherever there was any, for the reason that every department has been compelled to retrench in the effort to produce net revenue for the road as a whole.

In regard to securing uniformity for the purpose of making comparisons, it seems to me that it is not as essential, now that the final statements and exhibits of railroad expenses are made up in a uniform manner on blanks required by the Interstate Commerce Commission.

There is, however, no doubt that a comparison of methods used in making up shop accounts would lead to improvement and efficiency. It is the practice now of some roads to send representatives to visit shop accounting offices that have a reputation for efficiency for the purpose of studying the methods used in such offices.

In order that all roads might have the benefit of such study and comparison of up-to-date methods, it could be brought about by having meetings of shop accountants and chief clerks of locomotive and car departments at stated periods, which would be along the lines of the meetings or conventions of railroad storekeepers, and would be just as valuable. I think the results would justify the effort.

The following is a list of some of the subjects that it might be interesting to discuss and study at such meetings:

The best form of monthly time books, and monthly or semi-monthly payrolls, and daily time slips.

The best form of stock or material books for the different classes of material, also foremen's order cards, lot order reports, etc.

Locomotive performance statistics covering repairs, changes, additions and betterments, and engine failures.

Record of prices of every item of material purchased or of cost of articles manufactured in the shops.

Charges between the different departments, such as locomotive, car, engineering or maintenance of way, and transportation departments.

The method of checking and recording invoices for supplies purchased after same have been O. K.'d by storekeepers or foremen.

Method of making and recording bills against outside parties and foreign roads; this would cover bills for repairs of cars rendered in accordance with the intricate M. C. B. rules of interchange.

Record of coal purchased and distributed.

Method of filing and indexing correspondence.

I know of shop accountant's offices and shop offices where the methods in use are first class, but there is always room for some improvement and by having meetings such as suggested above it would afford the members attending an opportunity of exchanging ideas, making suggestions, exhibiting sample forms, discussing papers, etc., that would enable them to avail themselves of whatever would improve their methods.

Heat Treatment of Axles

By E. F. Lake, Consulting Metallurgist.

So many investigations have absolutely proven that a correct heat treatment will increase the strength, wearing qualities and resistance to fatigue of steel axles, that it seems a waste of time to argue over this proposition, and yet, some still claim that heat treatment is of no benefit to the kinds of steel that are used for axles. It can be granted that steels higher in carbon will respond more readily to heat treatment, but a knowledge of the right methods to employ in heat treating steels will enable one to raise the elastic limit and greatly increase the resistance to fatigue of steels that have a lower carbon content than those that are made into axles.

It is but a few years since wrought iron was considered to be superior to any of the steels for use in axles. A typical illustration is found in the first book that was printed about automobile construction; namely, "The Automobile—Its Construction and Management," by Gerard Lavergne. This was published in 1902 and translated into English by Paul N. Hasluck. On page 310 it says: "Consequently the axles must be made of the best metal. Steel, which otherwise is desirable owing to the facility of tempering of the journals, cannot be used, because it tends to become brittle under the influence of vibration; in any case only soft steel can be tolerated. Iron is almost exclusively employed, and it is selected soft and fibrous, giving an elongation as far as possible——." The numerous experiments and tests that have been made since that time have proven this to be false, however, and today the mechanical engineer would be considered ignorant if he should specify iron as the best metal from which to manufacture axles.

On account of the rough roads, the automobile axle may sometimes receive more severe strains than a railroad axle, but on the whole the strains and stresses to which both are subjected are very similar. The axle is located below the springs and hence it receives many rapidly repeated vibrational strains as a result of the wheels rolling over rail joints and many more severe strains from other causes. Thus the metal from which axles are made should be one that can be put into a condition that will best resist such strains. When steel is given the correct heat treatment it will refine the grain, remove all internal strains and make the cohesive force equal in all directions from any given point. Such a metal is certainly more able to resist the strains given axles than one which has not been heat treated, or one on which heat treatment only has a slight effect. Notwithstanding this, arguments are still advanced which attempt to show that car or locomotive axles give better results when in the condition in which they left the forge, or when in the annealed state. Such arguments are every bit as erroneous as were those that attemped to perpetuate the use of wrought iron.

Fig. 1.—Break Showing Strains Produced by Forging Hammer Blows and Also Crystallized Center Portion.

A good example of the internal strains that may be set up from the forging operation is shown by the view of a broken axle that Fig. 1 illustrates. In this case the effect of the hammer blows did not penetrate clear to the center of the axle and the high forging heat left the central portion in a crystalline condition that is very similar to that of cast steel. Around the outside, however, the hammer blows broke up this coarse crystalline formation and condensed the grain in a manner that gave it a very fine grain structure. The ridges that radiate towards the center, from the outer edge, show how one hammer blow overlapped another. They illustrate the internal strains that are set up by the forging operations. Rolling will also produce similar results. If this axle had been properly annealed, hardened and tempered these internal strains would have been reduced and any inequalities in the cohesive force that binds the molecules of the mass together would have been removed. It would also have reduced the crystalline structure in the center of the axle and made the grain much finer in that section. Then it would have been considerably more difficult for a crack to get a start and eventually cause rupture.

The principles on which the heat treatment of steel is based give a good idea of the benefits derived therefrom. As steel is being heated up it reaches a certain temperature at which it undergoes a revolutionary change. This is not far from 800 degrees, Centigrade, in axle steels. Some such changes take place at lower temperatures but these are not very important in the working or treating of steels. When the heat in the steel has reached this temperature it will not absorb any more heat until a complete transformation or rearrangement has taken place in the molecules of the metal. The result is, a new grain structure has been born and this is as fine and dense as any that can be produced in the particular grade of steel being heated.

This rearrangement allows the cohesive force to equalize itself in all directions from any given point and thus any unequal internal strains will be obliterated. If nothing more was done, than to allow the steel to slowly cool down from this temperature, the metal would be in a much better condition to resist any strains that axles are subjected to, than would a steel in the condition it is when it leaves the forging press or the rolling mill. If axles are properly hardened and tempered, after this annealing operation, their ability to resist such strains will be considerably increased.

In annealing axles the following three rules should always be obeyed:

First—The axles must be heated to a temperature that is above the highest transformation point of the steel, but as close to this point as possible.

Second—This temperature must be retained long enough to allow the entire piece to reach an even temperature, but it should not be prolonged beyond that.

Third—The rate of cooling must be slow enough to prevent any hardening from taking place, not even superficial hardening.

To harden steel these same rules apply, except that rule third is reversed. That is, the steel must be suddenly cooled, or quenched, instead of slowly cooled.

When the steel's temperature is raised above this highest trans-

Fig. 3.—Central Portion of Axle in Fig. 1 as Seen Under Microscope.

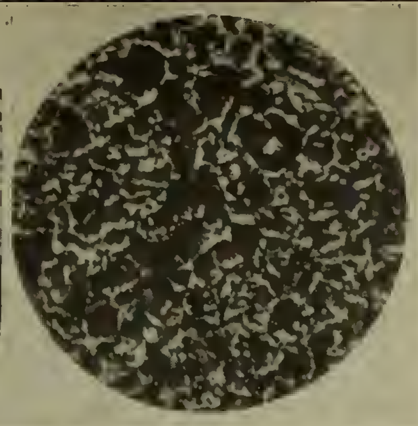


Fig. 2.—Outer Edge of Axle in Fig. 1 as Seen Under a Microscope.

formation point, the fine grained structure is coarsened in exact proportion to the number of degrees that the temperature is raised. The maximum temperature designates the size of grain that will be in the finished piece, as no method of cooling will afterwards reduce the grain size that was produced by the highest temperature to which the steel was heated. This coarsening of the grain weakens the physical properties of the steel in exact proportion to its degree of coarseness. Thus with the lowering of the elastic limit, a larger diameter of axle must be used to carry a given load; with the lowering of the fatigue resistance an axle will not withstand as many shocks or vibrational strains before a breakage occurs, and a lowering of the co-efficient of wear will cause axles to wear out quicker in the journals. Thus a correct heat treatment means so much to axles that it seems a waste of time, money and materials to not harden and temper them.

If the temperature of the steel was not raised too far above the transformation point, the coarse grain, that was thus produced, can be brought to its finer state by allowing the piece to cool and again following rules First and Second. After that it can be slowly cooled, as when annealing, or suddenly quenched, as when hardening. If the former temperature was raised to a degree that caused crystallization, such as is shown in the central portion of Fig. 1, the coarse grained structure can only be reduced by a reforging, rerolling, or other working of the metal. A still higher temperature might cause checks or cracks to develop between the crystals of the steel and then a remelting is the only cure. Such conditions of the metal are seldom discovered until the axles have broken and then it is too late to be remedied. The crystallization, found in a break, is often blamed to the vibrational strains a steel receives when in service. This is wrong, however, as crystallization is only produced by heating a steel to too high a temperature when it is being worked or treated.

The effect that heat treatment has upon the grain structure of steel can be plainly seen by giving the surface a high polish; etching it with a solution of picric or some other acid, and then examining it under a microscope. The illustrations are

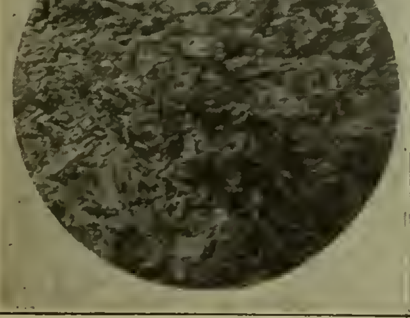


Fig. 5.—Nut Properly Annealed. Cooled Too Slowly.

Fig. 4.—The Same Axle After It Was Properly Annealed.

reproduced from photographs of such magnified sections of steel. Photomicrograph Fig. 2 shows a view of the steel at A, near the outer edge of the broken axle shown in Fig. 1. The steel is then in the condition in which it left the forge. Rolled steel will present a similar appearance. Fig. 3 shows a central portion of this same axle at B. Both of these were magnified 400 diameters.

The continually repeated vibrational strains, which an axle receives in service, will eventually cause the steel to check along the division lines between the white sections and the black areas.

In time these checks will develop into cracks that are very liable to rupture an axle. It can readily be seen that the coarse grained structure of Fig. 3 will allow such cracks to spread across an axle much more easily than would the finer grain shown in Fig. 2.

The proper annealing of an axle will make this grain still finer, and remove any internal strains that may be set up by the work of forging, rolling, etc. After being correctly annealed, this same axle steel is shown in Fig. 4. This puts the metal in a condition that will enable it to resist the vibrational strains for a much longer period before any checks or cracks will start to develop. But a correct hardening and tempering, after this, will make the steel still more tough and longer lived, and also cause it to wear longer in the bearings.

In Fig. 5 is shown a magnification of this same steel when it was not correctly annealed. In this case the metal was cooled

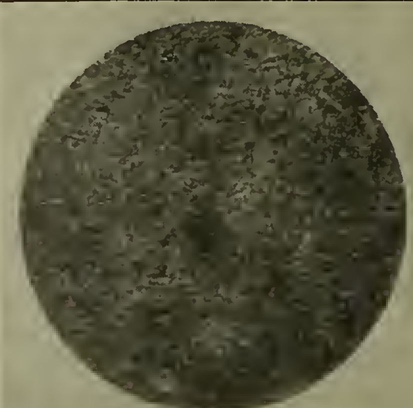


Fig.7.—Axle Steel After Hardening.

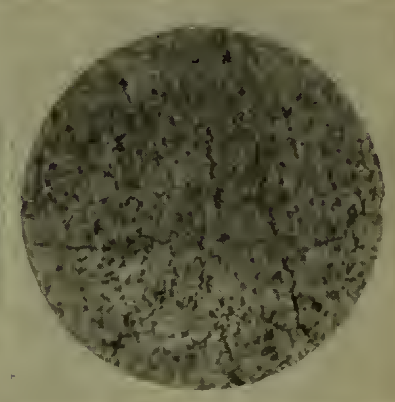


Fig. 6.—Annealed at a Temperature 100° Above Transformation Point.

too quickly and a superficial hardening took place. Such a steel would be more brittle than it should be for axle use. Fig. 6 shows how much the grain was coarsened by raising the annealing temperature 100 degrees too high. Its lighter color is due to its being etched with a different acid from those preceding.

The annealing leaves the steel in the softest condition in which it can be placed and it is very easily bent. Its tensile strength and elastic limit are also at the lowest point. Therefore annealed axles must be made larger than those that are afterwards hardened and tempered, in order to support their load; resist the strains to which they will be subjected, and not wear out too quickly in the bearings. Thus this extra weight of steel can be saved by a correct hardening and tempering.

Heating to a little above the transformation point and then suddenly quenching steel will put it in its hardest state. This hardening will raise the tensile strength and elastic limit to the highest point that can be reached in the grade of steel being treated. The elongation and contraction will be reduced to a minimum, however, and the steel will be in its most brittle condition. Before it is fit to use for axles it must again be heated up to a temperature that will draw out the right amount of hardness with its accompanying brittleness. The correct drawing temperature will put axle steels in their toughest condition and enable them to withstand the necessary strains.

By Fig. 7 is shown how the hardening operation alters the appearance of steel when seen under the microscope. The constituent martensite is produced by hardening. This formation resembles needle-like lines that cross each other frequently and intertwine themselves parallel to the three sides of the equilateral

Fig. 9.—Drawn Same as Fig. 8, but Hardening Temperature Was 50 Degrees Too High.

Fig. 8.—Hardened and Then Drawn at a Temperature of 400 Degrees C.

triangle. Here the fine martensite is seen that is producd by the correct hardening temperature. This can be greatly coarsened and the steel weakened, by raising the hardening temperature above the transformation point from 50 to 150 degrees, C.

When the steel is reheated for the tempering operation, the martensite gradually disappears to be replaced by troostite. The troostite has a somewhat mamalated appearance, but is nearly amorphous. It is only slightly granular. When the temperature has been raised to something like 400 degrees, C., the troostitic formation covers the entire surface of the steel, as the martensite has entirely disappeared.

In Fig. 8 is shown a specimen of steel axle that was hardened at the correct temperature and then drawn at 400 degrees. Only troostite can be seen in this specimen and also in the specimen shown by Fig. 9. This latter specimen went through the same drawing operation but the steel had been hardened at a temperature that was too high. The difference, in size of the grain structure, can readily be seen and accounts for the fact that the steel shown by Fig. 9 broke more easily than that shown in Fig. 8. This condition does not leave the steel quite tough enough to resist the strains that axles receive in service and consequently the drawing temperature was raised still higher.

When this drawing temperature goes above 400 degrees the

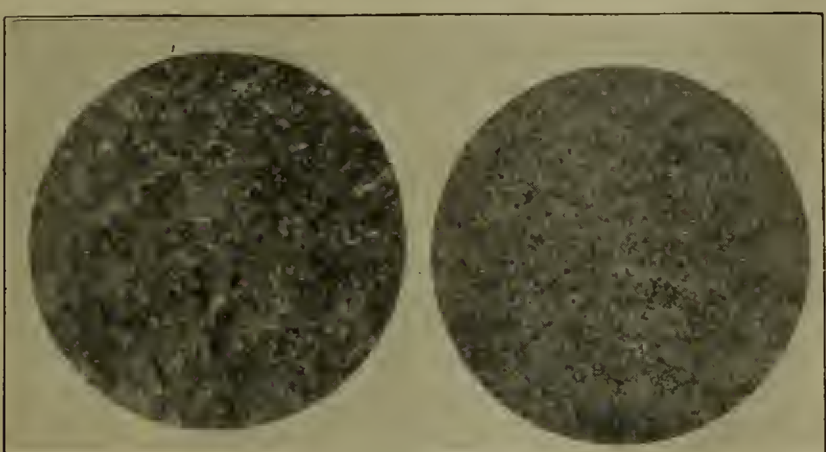


Fig. 11.—Coarser Grain Structure Than in Fig. 10.

Fig. 10.—Tough Sorbitic Structure Produced by a Drawing Temperature of 600 Degrees.

constituent sorbite begins to appear and replace the troostite. When a temperature of 600 degrees has been reached the troostite has entirely disappeared and only sorbite can be seen. The sorbite is composed of parallel plates of ferrite and pearlite, which are so small that they present a granular rather than a lammelar aspect.

In Fig. 10 is shown the sorbitic constituent that was produced by tempering the axle steel at 600 degrees, C. Fig. 11 shows the same thing, but from the coarser grained steel shown in Fig. 9, which was hardened at too high a temperature. The difference between the size of the grain structure in these two specimens will also be seen. This shows that any kind of heat treatment that is performed below the highest transformation point of the steel, does not reduce the size of grain structure that was produced by the maximum temperature to which the steel was heated during the hardening operation. Thus it shows the necessity of accuracy in the hardening temperature, if one is to produce axles with the longest wear and the greatest resistance to strains and stresses.

It is not difficult today to design and install furnaces and apparatus that will automatically control these temperatures within 10 degrees of any given point. Thus accuracy is not very difficult to obtain. Neither is it expensive, as labor with less skill can be utilized when the correct equipment has been installed. Numerous tests showed that the steel shown in Fig. 10 would wear several times as long as the annealed steels, when made up into axles, and also resist much greater strains and carry heavier loads. The gain in strength and toughness thus makes it possible to use axles of a smaller diameter for a given load, and the saving in pounds of steel might pay for the work of heat treatment, when it is done with the modern labor saving apparatus.

RECLAIMING MATERIAL ON THE SOUTHERN PACIFIC.

A. S. McKelligon, general storekeeper of the West Oakland general shops of the Southern Pacific, recently prepared the following statement showing the reclaimed waste and scrap material put into actual use at this shop from March 1st to September 30, 1914, a period of seven months. In the preparation of this statement, only material actually used was considered and the reclaimed material is figured at only half the price of the cost of new material. When it is considered that, in addition to the general shops at West Oakland, similar shops at Los Angeles, Sacramento and Portland, as well as division stores and smaller stores at various points on the line, are all now employing methods of this character, it is easy to understand that the aggregate yearly saving must be enormous.

Air Brake Material—consisting chiefly of Cutout and Angle Cocks removed from Scrap Pipe	$ 461.81
Brass, Copper and Lead—removed chiefly from Scrap Pipe, Hose, Castings, etc.	1,457.72
Pipe, Second-hand—sorted out from the Scrap	144.14
Fittings, Pipe—taken from Scrap Pipe—6,780 Fittings	228.36
Malleable Castings	561.88
Gray Iron Castings	113.95
Forgings	462.89
Bar and Angle Iron	64.52
Bolts, Nuts, Washers, Rivets, etc.	645.22
Couplers and Parts, Springs, etc.	1,368.95
Brake Beams	787.41
Track Bolts—49 Kegs (200 lbs. to keg)	145.31
Track Spikes—158 Kegs (200 lbs. to the keg)	315.20
Total	$6,757.36

Mr. McKelligon asserts that while the direct benefit of this reclamation has been great, it has likewise created a spirit of carefulness in using material on the line that is a great saving. Track men and station men are more economical and not so ready to discard material without a close examination as to its serviceability. Spikes are more closely picked over at the local tool house, pipe fittings on pipe and couplers and coupled parts are more closely scrutinized before they are condemned as useless. Tinware is being made over, for example, locally more than before. A. C. Carman at his mill has perfected a machine that makes car stakes from old piping butts and so on.

Reclamation is only possible with co-operation from everyone. And reclamation consists not only in the recovery of good material from scrap, but also in the prevention of material that could be used in the locality being turned in to the supply car only to be again sent out somewhere else on the system. The principle of reclamation is not to "scrap" anything that is not scrap, and this applies to the actual use of any article in its present form as well as to making it over into another form.—*Railway World.*

WOOD FRAME CARS IN FREIGHT TRAINS OF TODAY.*

By G. E. Smart, M. C. B., Intercolonial Ry.

A few years ago, the thirty-ton all wood freight car was considered standard, but since the introduction of steel in car building it has replaced wood and today we have all steel coal cars, all steel box cars, lined with wood inside, and steel underframe cars, of all classes 40 and 50 tons, and a few of 75 tons capacity.

There are a large number of wooden underframe cars still in service, and the question in regard to these is: "What can be done to make this class of car safe to be handled in the long trains and meet the severe usage that they receive in yard switching service of today?"

The draft gear problem is certainly the most important. The annual cost of repairs to cars that are damaged through the draft gear failure, and loss and damage claims resulting therefrom exceed all other repairs made to freight car equipment. The question naturally arises: "What are the causes of these failures?"

They are as follows:—

First. On account of introduction of heavier power and longer trains.

Second. Placing of light and heavy cars together in trains.

Third. Rough switching of cars in yard.

With regard to the first and second causes:

The tractive power of locomotives has increased during the last few years from 20,000 lbs., known as the 100% engines to about 45,000 lbs., or 225% for locomotives in general use in Canada, and the 2-10-2 type used on American roads to 84,000 lbs., and in addition to this type there are in use in certain sections of the country, locomotives of the Mallet type, with tractive power of 110,000 to 120,000 lbs., and, notwithstanding this enormous increase, there is a type of locomotive just placed in service, known as the Erie Triplex, with a tractive power of 160,000 lbs., with a haulage capacity equivalent to a train consisting of 250 fully loaded cars each of 50 tons capacity, 1.6 miles in length and a total weight of 18,000 tons. On comparing trains of the present day with those of a few years ago, the average number of cars hauled being 25, or approximately 1,000 feet long. Today the ordinary trains are 60 to 100 cars, and a train of 100 cars would be approximately 4,000 feet, or about ¾ of a mile long.

What chance has a wood frame car under the conditions as they exist today on the front end of such a train? In my opinion it is a very good reason why cars of this class are so often found on repair tracks, if a car of this type was to be traced from the time it leaves the terminal it would be found that it was necessary to remove parts of the load quite often, which beside the expense of repairs results in delay to freight en route, and it is the fruitful cause for so many claims on account of damage to freight handling in and out of the car.

The solution of the problem is not altogether the physical characteristics of the car or entirely mechanical. The operating official should co-operate with the mechanical department in reducing the freight car repairs by arranging as far as possible that cars with all steel construction or with steel underframe, or those with steel centre sills be placed in the front end of the trains. It is a fact that we find light capacity cars with wood underframe or empty flat cars leaving the terminal on the head end of one of the long trains. And in the majority of cases the cars are billed through and will not be set off between terminal points unless set off on account of draft gear failure. This, no doubt, could have been avoided had the cars been placed towards the rear of the train before leaving the terminal.

There are railways who recognize the necessity of placing weak cars toward the rear of the train, and they provide cards stating that they must not be placed more than 15 cars from the caboose. This indicates that the car is in such a condition that it must be so located in the train, but is safe in ordinary service to be hauled to destination, and if this is done delay and extra switching on account of draft gear failure along the line would be eliminated, and it would not be necessary to move the lading on account of this feature.

* A paper read before the Canadian Railway Club.

The third cause: "Rough switching in yard," is a great factor in car repairs.

The speed limit for switching in yards, is nil, nor are there any rules in force governing the speed of locomotives in switching service.

If you were to confer with the car inspectors and obtain their opinion as to where most damage is done to cars, I am safe in saying that their answer would be in the switching yards, as their daily experience in inspecting cars immediately on arrival and after they have been switched in yard will confirm this. This is only a small item as compared with actual damage started in yard and which through the cars being necessarily weakened thereby, is aggravated after leaving terminals, and results in many cases in the cars breaking down before reaching destination.

A visit to the freight car yard will convince you that it is just a question how fast the cars can be switched together, the speed that the cars are travelling is not considered hence cars are found buckled up in yards and the draft gear lying around, same having been pulled out due to rough switching.

There should be some speed limit in yards to prevent this destruction of equipment. The time lost in switching out bad order cars damaged in yard and taking same to repair track would often offset the time gained by excessive speed that cars are switched together. The cost of repairing these cars must also be considered, and the thousands of dollars of damage done to the contents of cars in yard that are not set off for repairs.

What is the mechanical department doing today to overcome these troubles?

First. They are building steel frame cars to certain specifications with stronger types of draft gear.

Second. Applying steel underframe or steel centre sills and steel ends, or otherwise re-inforcing the ends of cars to withstand the heavy shock.

Third. Applying different types of steel draft arms to the present wood centre sills in such a manner that it re-inforces the wood centre sills, thus greatly reducing the cost of strengthening up the draft gear.

Fourth. Applying heavier types of couplers and draft gear, and using friction draft gear, for in the past very little attention has been paid to what type of draft gear the cars were equipped with, but the friction type of draft gear is now being used to a large extent.

The demands of modern railroading require the stopping of a high speed train in about two minutes and the draft gear is expected to absorb the shock. The air brake department can help to eliminate the strain on the draft gear by instructing the engineers as to the proper method of handling the long trains. The principle thing is to control the slack to prevent it from running in or out harshly. Slack in draft gear cannot be prevented as it is due to compression of the springs and the heavier the locomotive and the longer the train, the greater the care that is required. Engineers are instructed in the air brake instruction car how this should be done, but the general air brake inspector should see to it that the rules are followed out in actual service.

The vital question today before the car department is how to keep these wood underframe cars in service. The majority of the railroads are destroying the 40,000 lb. cars, but the 60,000 lb. and 80,000 lb. cars that were built with wood underframe and short draft timbers are not any stronger and cannot withstand the heavy service and severe yard conditions of today, and unless the operating department will assist in reducing the damage done to cars and thus reduce freight car repairs, and also keep the cars in service by marshalling this class of car on the rear end of the train, and exercising greater care in switching cars in yard, the cost of freight car repairs will increase and the repair tracks will be full of bad order cars. The only other remedy is to spend money to apply steel centre sills or steel draft arms, so arranged as to strengthen the present wood centre sills, and in addition to this re-inforce the end of this class of cars. The strongest car built cannot withstand the severe usage received in yard switching today unless more care is exercised by the yard crews.

SAFETY PROBLEM OF RAILROADS.*

Since the initial construction of railroads their safe operation has been a subject of paramount concern to those upon whom devolved the manifold responsibilities of their management. This was sought to be attained by the promulgation and enforcement of enlightened rules dictated by the combined knowledge and experience of all persons upon whom this responsibility rested.

The great success that has attended their efforts to secure safety in the transportation of passengers is manifest in the fact that during the fiscal year ending June 30th, 1913 (the latest figures published), there were in round numbers one thousand million passengers transported by the railroads of this country, of which but 403 were killed and but 181 of these were killed in train accidents. The rest, or 222, were killed by other causes, such as getting on and off trains; struck at stations and in other like ways for which occurrences the victims themselves were probably alone responsible. The figures given include passengers carried on freight trains.

Accident insurance companies have long recognized the very great degree of immunity of passengers from death and injury in consequence of the provisions railroads have made for their safety, and evidence their confidence in the effectiveness of these provisions by giving passengers, for the same price, double the indemnity against injury they may sustain while traveling on a railroad that they can obtain against injuries liable to occur in their own homes.

While railroads have been able by vast expenditures of money on roadway and equipment and for safety devices; by educating trainmen in the knowledge of rules governing the movement of trains and being able, because of the necessity of keeping constant supervision over train movements, to secure to a large degree, obedience to those rules, to thus safeguard their passengers, it has not been possible for them to secure similar observance of rules promulgated for the protection of their employes generally from physical injury and death and whose retention in the service is of vital concern to them.

The inadequacy of rules and discipline to stop the annually increasing number of employe injury cases became apparent several years ago. A study of the situation revealed the reason to be that the employes, not the company or its officers, controlled the majority of the causes of injury sustained by workmen, and, therefore, the logical thing to do was to interest the workmen themselves in the removal of all causes of injury possible before such injury occurred, not afterwards. Not as a matter of obeying rules (which it seems it is innate human nature to resent), but because of the benefit that would come to them and those dependent upon them by so doing.

This thought originated in the mind of R. C. Richards, a veteran investigator of accident cases, was formulated into a working plan by him and tried out on the Chicago & North Western. Its success was immediate and so great that the plan was adopted and is now in successful operation on seventy-four of the great railroad systems of this country and Canada owning two hundred thousand of the two hundred forty thousand miles of railroad in these two countries. This employe safety movement has been in operation on these seventy-four railroads varying lengths of time. On some its inauguration is comparatively recent. I am in possession of data from three of the roads on which the movement has been longest in vogue, as well as some figures from seven other important railroads, which I think will definitely indicate what can be accomplished by an injury prevention movement managed by the employes themselves.

On three railroads with a mileage of 19,000 miles and 100,000 employes and an average of three years' experience in "Safety First" work, as compared with the same period prior to the inauguration of the employe injury prevention movement, a decrease of 457 fatal accidents, or 21 per cent, and a decrease of 14,843 non-fatal accidents, or 23 per cent, was effected.

On seven other railroads with a mileage of about 30,000 miles, during the first six months of the present year as compared with the same six months of last year, there were reductions made in casualties as follows: Fatal accidents, decrease 205, or 32 per cent; non-fatal accidents, 4,326, or 21 per cent.

The most difficult problems of railroad safety work arise from accidents, the causes of which are not within the control of the railroad company. It is this class of accidents that supply by far the greater number of cases to the casualty list. These accidents may be divided into two classes:

(a) Those which occur to the public.

(b) Those which occur to employes.

In regard to accidents which occur to the public, by far the most numerous are to those persons who use railroad tracks as walkways and those who steal rides on trains, including boys who hop on and off moving trains as a pastime. Notwithstanding the appalling loss of life and limb from these causes annually, the general public, which is profoundly shocked and indignant when life is lost or serious injury occurs in a train wreck, the sinking of a ship at sea, or in a highway crossing accident, takes no more heed of it than if as many flies had been destroyed, yet it is the general public alone that has the power to put a stop to this great loss in the productive power of state and nation and save the victims to lives of usefulness and contentment. The warning signs the railroads erect and maintain at great expense are a useless thing in checking track walking. This is all the railroads can do in that direction. As a part of the movement for injury prevention something has been accomplished, just how much it is not yet possible to say in figures, in persuading boys to abandon their train hopping and turn-table pastimes by talks to them at their schools, oftentimes illustrated by stereopticon views; the giving of safety buttons as prizes for learning and reciting some pertinent "Nevers"; by constructing swimming pools for their use on condition that they will keep away from the cars and not play on railroad premises; by reporting them to their parents and securing the aid of town officers. I know of several towns where the employment of some of these methods resulted in absolute stopping of these dangerous pastimes by the boys. I thoroughly believe that all that is necessary to keep a boy from indulging in dangerous sports is to provide him with safe and attractive ones in which he can expend the excess energy of his youth. This, however, is a duty to the boy that should be performed by his parents or by the community in which he lives. Railroads should be relieved of this task.

A second difficult public safety problem is the ever increasing number of persons who, while riding in automobiles, are struck on highway crossings by rapidly moving trains. As there is fifty feet clear space on each side of all railroad tracks, assuring a clear view of an approaching train, if one will look and as an automobile can be stopped in ten feet even when moving at a high speed, there seems no excuse for such ocurrences except the spirit of chance taking automobile driving seems to inspire in many persons.

In respect to accidents that occur to employes, I am firmly of the opinion that the most difficult problem in railroad safety work is to arouse a genuine, active, heartfelt interest in the foreman in safety work (I intend that the word "foreman" shall include every man, whatever his title, who has immediate authority over and the direction of other men in their work), an interest that is based on his own mental conviction that the prevention of injury of each individual workman will increase the efficiency and production of all, lessen the cost of production and bring personal credit and promotion for himself and therefore of the first importance to him if he desires advancement. A conviction that when he has once secured a satisfactory and competent force of men that the loss of any one of them is a loss that affects him personally and detrimentally. A conviction that will cause him to give his workmen the same supervision and care to guard them against injury that he would instinctively give to a very valuable animal or a delicate and expensive machine he might own, and

*A paper read by W. B. Spaulding at the annual meeting of the National Council for Industrial Safety at Chicago, October 15, 1914.

for the very same reason, i. e., because it is the sensible thing to do.

A foreman interested in safety work because he had the intelligence to perceive its resultant benefits made the statement to me that "foremen would not help safety." The foreman who made this statement was an exception to it and I knew personally of several other exceptions, yet I also feel equally certain that as a general statement it was a true one. This statement did not mean that foremen generally were indifferent to the safety of their men and would not regret the injury of any of them, but it did mean that the average foreman's first concern was production—the accomplishment of the work with a dispatch and at a cost that would reflect credit on him, and as the ideas underlying the movement for greater safety for workmen conflicted with notions and methods of doing work to which foremen generally had long been accustomed, they would be opposed to a change which, though it would eliminate risks, would, in their judgment, retard the work and cause some loss of time to the men.

MY ATTITUDE TOWARD THE STORE DEPARTMENT.

By a Roundhouse Foreman.

There exists between no two departments as much mystery as exists between the roundhouse and shop and the store department. Some would not call it mystery, but call it hard feeling, and think that each other is in the fault. As a shop foreman, having had experience in the purchasing agent's office, I will try to eliminate some of the mystery of each department.

The store department is like a big department store. When you have the money you may purchase its equivalent in goods, and to get credit you must give good reference. So it is with the shops and the store department. Always see that the man has a requisition for what he is sent after, as the storekeeper is just as responsible for the goods under his charge as the head of a big department store, and credit is as hard to get, for he is a good business man.

In making your requisitions out, see that full information is given on them. Not "six bulls-eye lubricator glasses," but state make of lubricator and number, for this helps both the store department and the shop and roundhouse foreman as well. In fact, put all the information on that will help the man at the storekeeper's supply desk, save his time and the time of the man you have sent after the material, and the clerk's time in the store department, also useless correspondence between the two departments.

Try to state your wants as far in advance as possible to the store department, and don't order four when you only want one. Would you go to a tailor shop and order four suits of clothes, and when they were done take only one suit and leave the other three there? What would the tailor think of you?

So each department must be careful in ordering. The shops must order only what they want and the store department must study the requisitions and carry only what is needed.

There is the cause, I will say, of most of the mystery that exists between the two departments. It is like the story of the shepherd who would wave his coat from the hill where his flock of sheep fed, just to see the men from the village come to drive away the wolves. And he did this many times in jest, but one day the wolves came and he waved his coat, but the men did not come and the wolves devoured the sheep. So it is with the shop and roundhouse foreman. We order something special from the store department, got to have it at once, going to camp in the storekeeper's office until it comes. Well, it came last week and is still over at the storehouse. You want that piece of material to put aside for some future job, yet you hate to give a requisition for it, for you are watching your daily engine repair cost. But you are asking the storekeeper to take the money out of his pocket to purchase your goods with and you are giving him no interest for it.

There is no piece of material that is thrown away by the shop and roundhouse as much as globe valves. When a man finds anything wrong with a valve he gets a requisition and draws a new one and scraps the old one. These can be taken care of in the air room or tool room and made as good as new. Old driving box brasses can be put on a shaper and cut into stick brass by an apprentice; these can be turned into the store department for small outside points, and for the shop and roundhouse as well.

Are you going to shop an engine? Give the storekeeper a list of what material you will need for that engine, and he will help you out by checking over what he has on hand, and you can arrange for the balance by placing orders with him.

Shop foreman and roundhouse foreman, invite the storekeeper to go through the shops and roundhouse with you. Ask him for suggestions where you can save money. He will appreciate your invitation, and no doubt give you some good advice. Just treat the storekeeper as you would any of your business acquaintances, and you will be surprised how much you can learn about the silver dollar, its purchasing value, and what the watchdog of the railroad (the storekeeper) knows about it.—*The Railway Storekeeper.*

A SUBSTITUTE FOR FILES FOR TRIPLE VALVE REPAIR WORK.

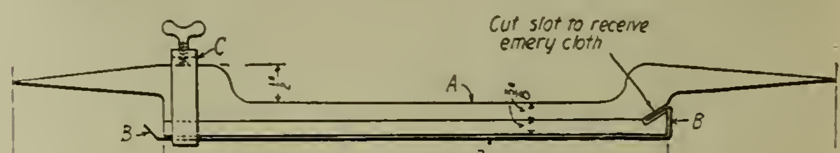
By Frank J. Borer, Air Brake Fmn., Cent. R. R. of N. J.

When triple valves have been in service for a considerable length of time and are removed from cars or engines to be cleaned and repaired, a good many of them have leaky slide valves, on account of elevations and depressions at the face of the slide valve and the slide seat. This is due to uneven wear between the two surfaces.

When repairing such valves, it is necessary to first file the face of the slide valves as well as the slide valve seat perfectly straight before the work of grinding in the slide valve should be commenced with.

Common, flat, smooth files are not suitable for this work and it therefore has become a practice in many shops to use special cut square files at an average cost of about $1.50 each.

Our superintendent (at the C. R. R. of N. J. shops at Elizabethport, N. J.), Mr. G. L. Van Doren, has designed a simple device as shown in the sketch which does away with the expense of purchasing special files and the results are in every way just as satisfactory as if the work had been done with a special file.



Device for Triple Valve Repair Work.

Referring to the sketch, A is a piece of T iron planed off on the under side to receive a strip of emery cloth of the proper width. The ends of the T iron are finished to receive a file handle. B is a piece of emery cloth and "C" is a little clamp to hold the emery cloth stretched to the T iron.

The expense of the emery cloth in comparison to a special file is insignificant. Special grades of emery cloth may be used.

We find the device useful for different kind of jobs besides triple valves, such as slide valve feed valves, distributing valves, etc.

The newspaper accounts of the arbitration proceedings going on between the railway managers and Brotherhood of Locomotive Engineers make it appear that some of the engineers who are employed on western railroads are daily practicing heroic self-sacrifice instead of performing duties that are strictly routine.

A few years ago this spectacular notoriety about the daily work, which will always be accompanied by more or less danger, was not even heard of, much less advertised in the daily papers. We shall next hear of the heroic sacrifices made by demented chauffeurs who evade the speed laws.

SAFEGUARDING THE HIGH--SPEED GRINDING WHEEL.

The ordinary grinding wheel in service has a circumferential speed of approximately 5,000 feet per minute. It is alternately subjected to periods of no work and of violent shock when it strikes the surface of a casting or grinds its way through a piece of solid metal. While remarkable success has been attained in bonding together the gritty particles composing the wheel, the elements of the bonding process cannot be so accurately controlled as to insure the absolute safety of every wheel. While each wheel is carefully inspected and tested, yet sometimes wheels do burst. The majority of such accidents, however, are due to the abuse of wheels in service and not to faults in manufacture. The possibility of wheels bursting renders the provision of safeguards absolutely essential. The approved methods of guarding wheels are described in recently issued bulletin of the National Founders Association, which is abstracted below.

Varied work conditions require the use of wheels of many shapes and degrees of hardness and size of grain. Plain wheels may be safely run at higher speeds than cup or special shaped wheels and hard wheels at higher speed than soft. It is the custom of grinding wheel manufacturers to attach a label to each wheel, indicating the safe maximum speed of that particular shape and grade of wheel; these recommended speeds should never be exceeded.

To secure the greatest efficiency of grinding wheels, they should operate at the safe maximum speeds; most machines therefore, are equipped with cone pulleys offering two or more speeds to equalize the wheel's cutting efficiency. This arrangement may be dangerous because the belts on such machines may be shifted by men who do not realize the danger of overspeeding, which is a frequent cause of the bursting of grinding wheels. Moreover, when a small wheel is replaced by a large one, the operator is apt to neglect to return the belt to the large pulley, thereby producing an excessive, unsafe speed.

Safety devices can be installed, at a comparatively small expense, to successfully overcome these hazards. Fig. 1 shows a belt locking device on a machine equipped with a two-step cone pulley. This is automatically controlled by the diameter of the wheel in use, and will prevent excessive speed as well as the use of oversize wheels. When the cone pulley has three or more steps, the belt may be secured in the proper position by the belt lock shown in Fig. 2, while the use of an oversize wheel is avoided by attaching an adjustable wheel-limit stop, also shown in Fig. 1. A sign attached to the machine stating the revolutions per minute obtained by the use of each step is of much value.

Some managers use single speed machines equipped with permanent wheel-limit stops, as shown in Fig. 1, and are content to thus sacrifice efficiency to safety. In other plants, however, where a number of machines are used for one grade of work, single speed grinders, each of different speed, are used and wheel-limit stops are provided. Maximum efficiency is maintained by transferring wheels successively from low to higher speed machines as the wheels wear small. Protecting hoods of the right diameter, on single

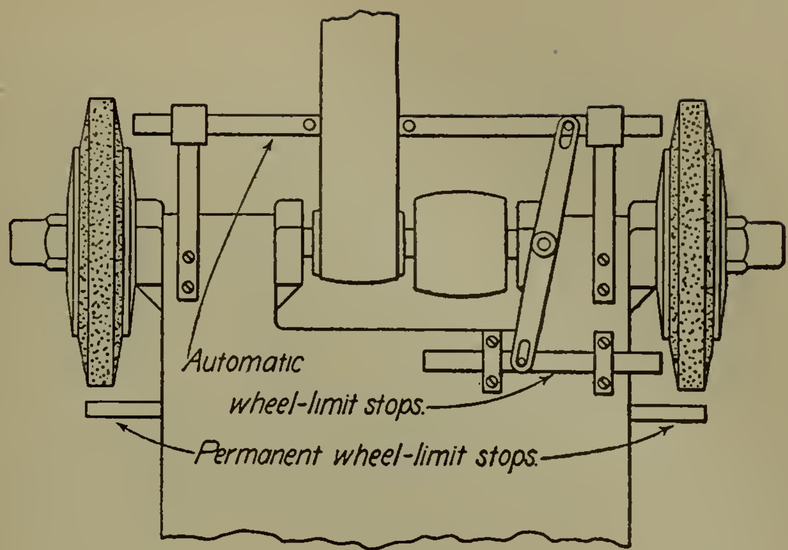


Fig. 1.

speed machines, limit the size of wheel used, and other wheel-limit stops are unnecessary.

WHEEL TOO HEAVY FOR ITS SPINDLE.

A grinding wheel too heavy for its spindle, will cause the spindle to run out of true and possibly break. This may prove as disastrous as the breakage of a wheel. Table I gives the spindle diameters which reputable grinding wheel manufacturers recommend for various sizes of wheels.

Before mounting a grinding wheel upon its spindle it is well to examine the wheel for cracks; a cracked wheel, when lightly tapped with a hammer, will not ring clear. The wheel should slide on the spindle easily, but not too loosely. If forced on tightly, the wheel is apt to be broken. A clearance of 0.005 inch is considered satisfactory. Excessive heating of bearings and shaft should be avoided by frequent careful adjustment and by the use of automatic grease cups or self-oiling bearings, amply protected from dust and grit.

THE USE OF FLANGES.

It is advisable to confine within flanges as much of the wheel as is practicable, and it has been generally agreed that wheels covered by flanges of less than one-half the diameter of the wheels are unsafe. Where feasible, the wheels should not project more than 2 inches beyond the flanges, and several sizes of flanges should be provided to suit the reduced size of the wheels.

The clamping action of flanges should be effective at their circumference in order to compress the wheel at the outer edge of the flanges and not at the center. To accomplish this the flanges should be recessed toward the center. Steel flanges are more dependable than those of cast iron.

Both inner and outer flanges should be of the same diameter, in order to prevent straining the wheel. When flanges of one diameter are used exclusively, the inner flange should be pressed securely on the spindle, but when flanges of various diameters are used on the same spindle interchangeably, all inner flanges should be keyed. This is necessary to provide a true bearing for the

TABLE I--SMALLEST SPINDLES FOR VARIOUS SIZES OF GRINDING WHEELS

Diameter	Maximum Thickness of Grinding Wheels, in Inches.													
of wheel	1	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½	5	5½	6
8	¾	¾	¾	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1¼
9	¾	¾	¾	¾	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼
10	¾	¾	¾	1	1	1	1	1	1¼	1¼	1¼	1½	1½	1½
12	¾	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	1½	1¾	1¾
14	1	1	1	1¼	1¼	1¼	1¼	1½	1½	1¾	1¾	1¾	1¾	1¾
16	1	1¼	1¼	1¼	1½	1½	1½	1¾	1¾	1¾	1¾	1¾	1¾	2
18	1¼	1¼	1¼	1½	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2
20	1¼	1¼	1½	1½	1¾	1¾	1¾	1¾	1¾	2	2	2	2	2¼
22	1¼	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼
24	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2½
26	...	1¾	1¾	1¾	1¾	2	2	2	2¼	2¼	2¼	2¼	2½	3
28	...	...	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2½	3	3
30	...	...	1¾	2	2	2	2	2¼	2¼	2¼	2½	3	3	...
32	...	...	2	2	2	2	2¼	2¼	2½	2½	3	3	...	...
34	...	...	2	2	2	2¼	2¼	2½	2½	3	3	...	...	...
36	...	...	2	2	2¼	2¼	2¼	...	...	...	...	...	...	...

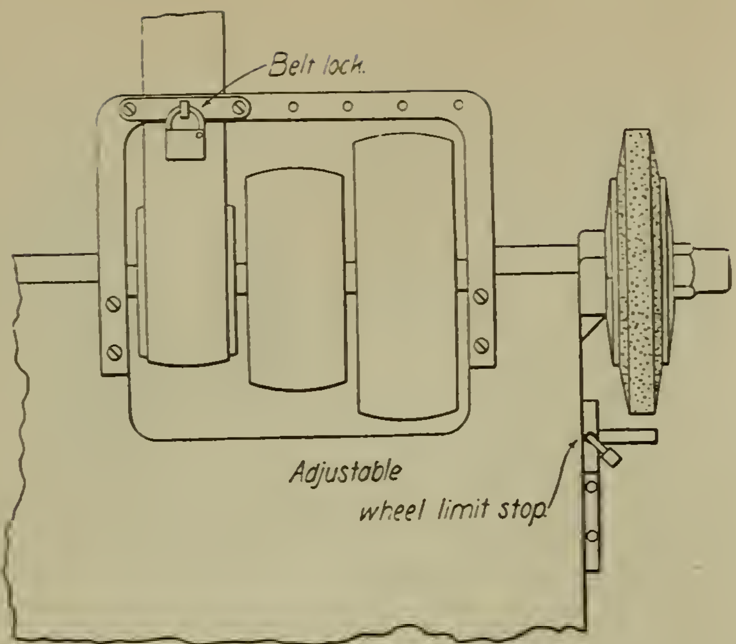


Fig. 2.

side of the wheel and to counteract a tendency of the nut to creep.

To obtain uniform pressure of the flanges upon the rough sides of the wheel, washers made of soft blotting board or of $\frac{1}{16}$-inch sheet rubber should always be used between the flanges and wheels. These washers should be slightly larger than the diameter of the flanges. Blotting board washers are suitable for light service. Rubber washers, while a little more expensive, make a better cushion contact between the flanges and wheel and hold the wheel more securely.

THE DANGER OF ABNORMAL VIBRATION.

When finally the wheel is secured upon the spindle by the clamping nut, care should be taken to tighten the latter only enough to hold the wheel firmly; otherwise the clamping strain may crack the wheel.

If either the wheel or the frame of the machine should vibrate abnormally after the wheel has been thus carefully mounted upon a spindle of proper diameter, and operated at normal speed, the cause may be found in weak foundations, an unbalanced wheel, imperfect bearings or shafts, or the machine itself may be too light for the weight of the wheel it carries. Abnormal vibration is apt to shatter the wheels and this hazard must be promptly removed.

Wheels are usually in good balance when they are shipped from the factory. They, however, are subject to greater wear at some points than at others, and should be dressed and trued at frequent intervals. The dressing tool itself should be of the guarded type. Grinding wheels should be kept in a dry place. Wheels used for wet grinding should not be allowed to stand idle in water, as the heavy water-soaked or damp portion of the wheel will throw it out of balance.

THE USE OF PROTECTING HOODS.

Even though operating conditions may be good, grinding wheels nevertheless sometimes will break in service. Protecting hoods, therefore, should be provided to hold from flying the parts of a broken grinding wheel.

Safety grinding wheels usually are tapered on both sides, and are clamped between tapered steel flanges, concaved to fit snugly the tapered sides of the wheels. To insure accuracy of fit, safety flanges and safety wheels should be furnished by the same manufacturer.

While safety wheels have prevented many injuries, they are not absolutely dependable. The unbalanced momentum of a broken wheel is often sufficient to spread the flanges and allow broken parts of the wheel to escape. Even safety flanges cannot retain broken pieces which may fly from the unconfined rim of a grinding wheel. Safety wheels are chiefly desirable in special cases when the character of the work absolutely prohibits the use of hoods, and even then extraordinary care must be taken to maintain favorable operating conditions and moderate speeds.

A protecting hood is the best and safest method of guarding against injuries from broken grinding wheels. When possible the hood should be of such construction as to serve also as a dust hood which, when connected with a suitable exhaust system, will eliminate the injurious effects of grinding dust and at the same time protect against accidents. Such combination hoods are regularly made and form a part of modern machines; it has also been found practicable to install such hoods upon old machines.

Cast steel or rolled steel hoods are safer than cast iron hoods; the latter are not dependable, except for light wheels. Hoods should be amply strong to serve their purpose. The inside diameter and width of the hoods should be sufficiently larger than the corresponding diameter of the wheel to allow proper clearance. The hood should also enclose the spindle end, but if the character of the machine will not allow this, a separate guard can be provided as illustrated, to prevent the workmen's clothing from catching in the spindle threads. The hood should enclose the wheel as much as possible and leave an opening only large enough to satisfactorily apply the work to be ground. If the opening is too large it will permit the escape of broken parts of the wheel and thus frustrate one important purpose for which it is designed; it will also require a greater volume of air for proper exhaust.

Grinding dust should be carried away by an adequate exhaust system. Where this cannot be done, the eyes of operatives should be protected from the dust by approved eye protectors.

For safe and convenient handling of work while it is being ground, grinding wheels are usually provided with work rests; these must be adjustable and workmen should be encouraged to keep them as close as possible to the wheel. Otherwise the workmen's fingers may be drawn between the wheel and work rest or pieces of the casting or even the casting itself may become wedged in the opening and damage the wheel or the workman or both. The clamps for fastening the work rest in place must be effective in their action, so that work rest may not be forced away from the wheel at a critical moment.

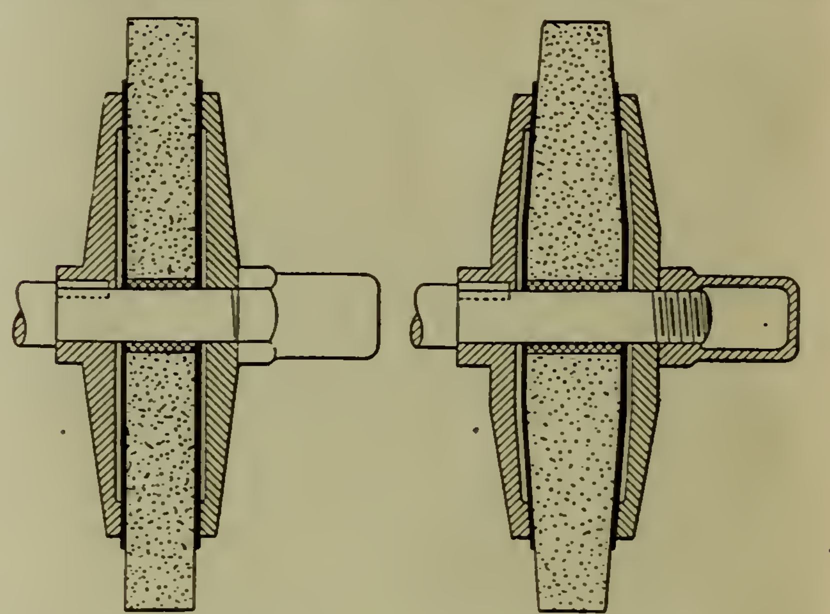


Fig. 3.—Proper Forms of Flanges and an Improved Safety Nut.

In order to avoid striking hard blows on the sides of wheels when handling heavy or cumbersome castings, a chain hoist will prove an economical investment. By its use castings may be safely held while workmen guide them against the wheel. Suitable tables or rests can be devised for the same purpose as the chain hoist.

Wherever belts are used on grinding wheels they should be enclosed in guards of sheet iron, expanded metal or heavy wire screen, attached to angle iron frames. The belts should be guarded to about 7 feet above the floor.

To prevent stumbling against the machine, the floor about it should be kept free from castings or other obstructions.

The foregoing recommendations are adaptable to machines now in use. If, however, new machines are to be installed, it is advisable to insist that they be equipped with every safeguard. Grinding machines are mostly of the belt-driven type. Electrically-driven machines are now finding increased use; they are usually

equipped with constant speed motors, which, together with the protecting hoods and devices to limit the size of grinding wheels, give safe conditions of operation. Some manufacturers equip their machines with variable speed motors in order to maintain maximum operating efficiency. Such machines should have devices to guard against over-speeding, for instance, through automatic connection between the motor speed regulator and the diameter of the grinding wheel.—*The Engineering Digest.*

STAYBOLTS.

By George L. Price.

At present three kinds of staybolts are beiug used in locomotive boilers—the rigid, the hollow and the flexible bolt. Staybolt breakage has been eliminated to a great extent since the introduction of the flexible bolt. In fact, staybolt breakage and the remedies for eliminating breakage have been live topics of discussion for many years.

Years ago expansion and contraction were not taken care of by the use of flexible bolts, but an attempt was made to restrain the expansion and contraction by the use of heavy sheets, large staybolts, heavy bracing, etc. Before the flexible staybolt put riveted over, was made from a solid bar of iron of the best quality, in its appearance, the rigid bolt, threaded on both ends and but, nevertheless, led to breakage regardless of all modifications in form, shape and size, with additional changes in quality to strengthen the bolts. From this it is natural to conclude that it is not so much a question of quality in the material as it is a question of too much rigidity in construction.

FLEXIBLE STAYBOLTS.

The flexible staybolt has proved a large factor in the elimination of inequality of expansion in locomotive boilers. It is impossible to restrain or restrict the expansion of material without disturbing its structure. A rigid staybolt under normal conditions, considering the tensile strength and the stress under pressure, has a large factor of safety, but, owing to the vibratory stresses due to the expansion and contraction of the firebox sheets, and due to the fact that the bolt being threaded opens an avenue for a fracture which will result in a break, the rigid staybolt has always given a great deal of trouble.

I have often been asked the question, why is it that a rigid staybolt generally breaks flush with the inner surface of the outside sheet? While I have never seen anything authentic in regard to this, the following reasons seem to me to be logical: As the inner firebox sheets are generally about one-half the thickness of the outside sheets, they become heated before the outside sheets and start to expand first, thus causing the inner, or firebox, end of staybolt to travel in the direction of the stress, while the outside end of the bolt, which is at a lower temperature and is held more rigidly, moves only a comparatively small amount at first, but eventually travels a greater distance than the inner sheet, owing to the fact that the outer sheet is a larger and thicker sheet, and consequently expands a greater amount when the temperature is increased. The continuous vibration upon the staybolt, together with the tensile stress, or load, due to the pressure on the bolt, will eventually break the staybolt. Breakage in this way generally takes place when the engine is being fired up after a washout, therefore it is logical to believe that the hot water system of washing out would lessen the breakage of rigid staybolts.

Staybolts not only act as a connecting agent to hold the outer and inner firebox sheets together against boiler pressure, but they are also compelled to withstand excessive bending stresses, set up by the unequal expansion and contraction of the inner and outer sheets. The load upon a staybolt, due to the boiler pressure, is comparatively small as compared to the stress induced by the inequality of expansion and contraction.

STRENGTH OF STAYBOLTS.

The strength of a staybolt should be calculated from its smallest area. Staybolts are made from wrought iron on account of its fibrous structure, which will stand more abuse from the different stresses acting upon the bolt than will steel, which is of a crystalline structure. All staybolts become more or less crystallized by the rapid blows of the hammer in riveting, although it is impossible to judge the amount of crystallization occasioned by the riveting process.

Inferior installation of flexible staybolts often gives us considerable trouble. We have been calking the flexible bolt thimbles or bushings in the roundhouse for the last three years, and, furthermore, we have not finished calking yet, and probably will not have finished until we have gone over the entire lot of bolts. We may attribute this defect to inferior installation during the construction of the boiler in the locomotive works. This is an expensive item for our railroads to contend with, and it should be eliminated.

APPLICATION OF FLEXIBLE BOLTS.

When applying flexible staybolts, the adjustment of the bolts should be taken into consideration, although this is not uniform for all types of boilers. When firing up a locomotive boiler, the inner firebox sheets expand more rapidly in an upward diagonal direction than the outer sheets. As steam is raised to its working pressure the outer shell expands in a direction which extends longitudinally to a greater extent owing to its larger dimensions and greater thickness. The difference in the amount of expansion between the sheets varies in different types of boilers and, for this reason, bolt adjustment should be based upon data obtained by tramming the firebox for the difference in sheet expansion. However, the writer is of the opinion that the following course of adjustment is adaptable for fireboxes 8 feet long and under:

ADJUSTMENT FOR SIDE SHEET AND BACK HEADS.

Taking into consideration the first, second and third outside rows and the same across the top, the bolts in row No. 1 should be given a half turn back; those in row No. 2, three-eighths of a turn back, and those in row No. 3 a quarter of a turn back. For fireboxes 8 feet in length and over, the bolts in row No. 1 should be given three-quarters of a turn back; row No. 2, one-half of a turn back; row No. 3, three-eighths of a turn back.

For the adjustment of the throat sheet, taking the first three rows above the mudring, the first row above the mudring should be tight; the secoud row, three-eighths of a turn back; all other rows, three-quarters of a turn back.

When large areas are covered by flexible staybolts, all bolts inside of the three outside and the three top rows should be turned back off of their seats one-eighth of a turn, because riveting has a tendency to draw the bolt up to its seat.

Staybolts should have a larger factor of safety than the boiler shell or plates, on account of its being subject to both a direct and an indirect pull, as well as an unequal vibratory stress. For this reason I do not think it is practical to admit staybolts in the rivet line when applying a patch to firebox sheets.

EXAMPLES.

What load is carried by a staybolt when the bolts are spaced 4 inches between centers and there is a steam pressure of 150 pounds per square inch? The load carried by the staybolt is equal to the area it supports multiplied by the steam pressure per square inch, which, in this case, will be $4 \times 4 \times 150 = 2{,}400$ pounds. This is, of course, disregarding the area of the bolt itself.

If we allow 6,000 pounds stress per square inch for staybolts, what area would a staybolt support, the least diameter of the bolt being ⅞ inch and the allowable working pressure 200 pounds per square inch? First determine the area of the staybolt as follows:

$$.7854\ (.875)^2 = .6013.$$

Then multiply the area of the staybolt by the allowable stress per square inch, and divide the result by the allowable working pressure, giving the area as follows:

$$\frac{.6013 \times 6{,}000}{200} = 18.03.$$

Finally extract the square root of the quantity representing the area, and you will have the spacing or pitch of the staybolts:

$$\sqrt{18.03} = 4.25, \text{ or } 4\tfrac{1}{4} \text{ inches.}$$

What force will a staybolt resist whose smallest diameter is

3/4 inch, the diameter at the root of the thread being 7/8 inch, with a 3/16-inch telltale hole, and the allowable working stress 6,000 pounds per square inch? First the area at the root of the threads must be determined. From this value deduct the area of 3/16-inch telltale hole, or $(.875)^2 \times .7854 - (.1875)^2 \times .7854 = .5737$ square inch.

The area of the staybolt at its 3/4-inch diameter will be $(.75)^2 \times .7854 = .4418$ square inch. The area for the 3/4-inch diameter being less than the area at the root of the thread minus the area of the telltale hole, the load allowed is computed from the 3/4-inch diameter and is: $.4418 \times 6{,}000 = 2{,}650$ pounds.

THE HAMMER TEST.

Boilers are sometimes put under pressure of from 40 to 50 pounds per square inch to aid the inspector in locating a broken staybolt with the hammer. Putting the pressure on the boiler causes the two parts of the broken staybolt to separate, thus permitting the broken staybolt to be more readily found.

All staybolts, crown-bolts and radial bolts should be placed so as to be at right angles or 90 degrees to the sheet they support. When the pitch of the staybolts is excessive, the pressure will bulge the sheets and thus create a deformation.

Staybolts should project beyond the sheet about two threads to form a head in driving the bolt. Excessive allowances make it difficult to upset the staybolt in the hole. The smallest size staybolt advisable for high-pressure boilers is 7/8-inch diameter.

In the distribution of staybolts and braces, every effort should be put forth to distribute them so that each staybolt or brace will have the same working stress per square inch; that is, as nearly so as practicable. In arranging staybolts, attention must be paid to the size of the staybolt, the pitch and the thickness of the plate it supports. It may be possible that the staybolt or brace will be large enough to support the area allotted to it, but the plate may be so light that the pitch will be excessive and cause deformation of the plate. In deciding upon the pitch it is necessary to know for this purpose.—*The BoilerMaker.*

REMOVING NUTS FROM SCRAP BOLTS.

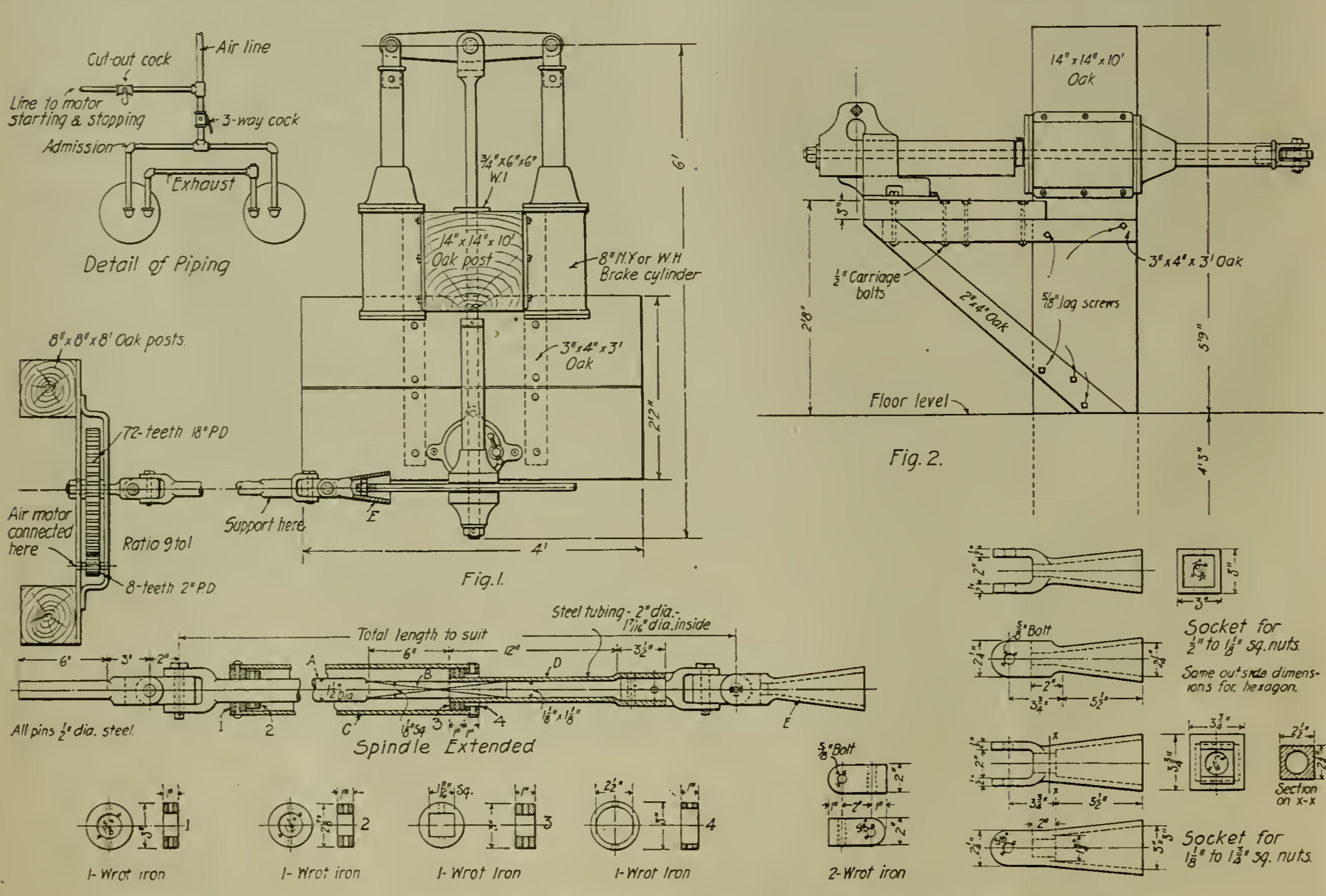
By W. T. Walters.

This machine, which is in use on the scrap platform of the Illinois Central at Memphis, Tenn., was designed with a view to reducing the time taken in removing nuts from bolts and rods taken from destroyed cars. The old method was to remove each nut by means of a wrench. This took an average of five minutes per nut and where the nuts were rusted on, often proved impossible. Accordingly this machine was built and to date no nuts have been found too stubborn for the machine to remove. As can be seen by the illustration it is driven by means of a pinion and gear, and any air motor of sufficient power is connected to the pinion. The gear in turn is fastened to the spindle which consists of a spindle "A" with a square on it "B," revolving inside a casing "C." The hollow spindle "D" is formed from a piece of 2" steel tubing formed to 1⅛"x1⅛" square. This hollow spindle "D" has a movement of six inches.

Briefly the operation of removing nuts is as follows: The rod or bolt is gripped in the jaws of the vise operated by air, which proves a very efficient method of holding same. The head "E" attached to spindle "D" is brought forward and placed over nut as shown in Fig. 1. Air is now admitted to the motor and the rotary movement of "A" communicated to "C" causes the nut to revolve. Its own action moving along the bolt presses it tightly against the head "E" which in turn being attached to "D" moves backward taking the nut with it. This machine averages three nuts removed per minute and has resulted in a considerable saving. The cost of machine is almost negligible.

The first machine of this typewas built at the Harahan shops of the Illinois Central by C. C.Roddie, district foreman.

The New York Central & Hudson River is contemplating the expenditure of $3,000,000 for improvements on Pennsylvania Division. The larger part of this sum is to go for additional shops at Arvis and other improvements at this point.



Machine for Removing Nuts from Scrap Bolts and Rods.

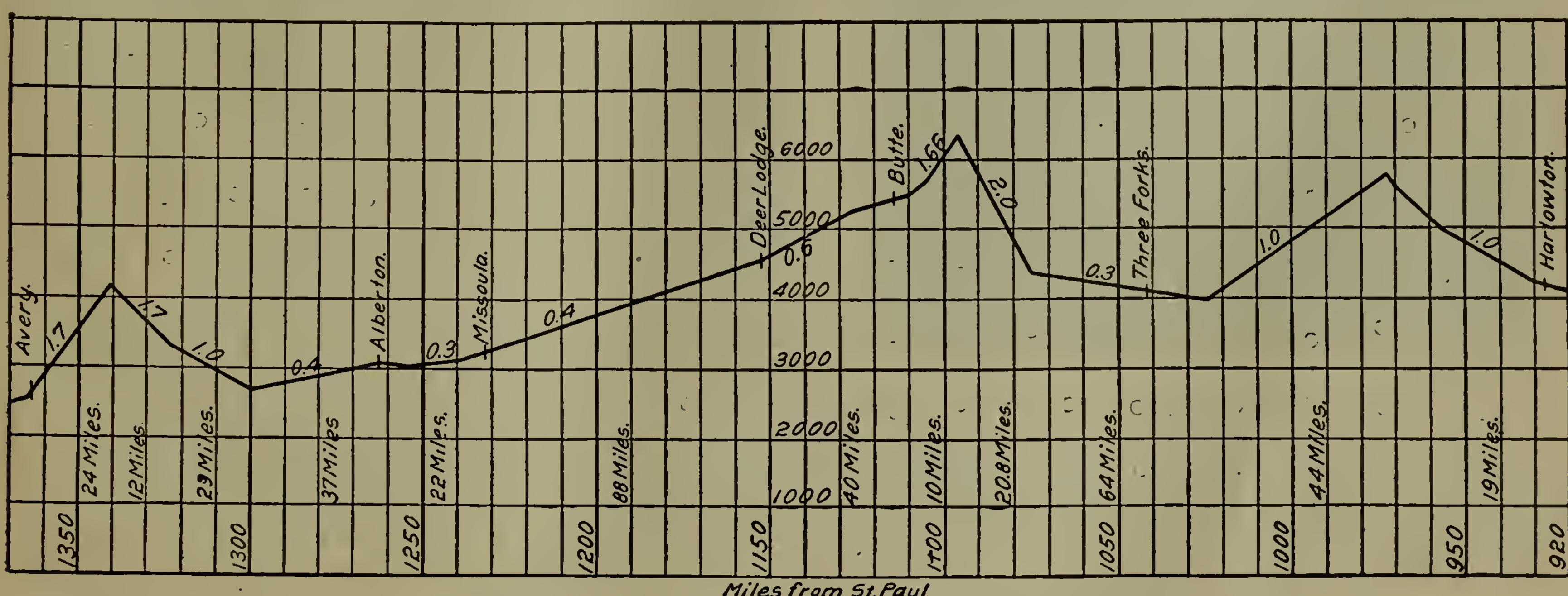
C. M. & St. P. Electrification

Plans for the electrification of the first engine division of the Chicago, Milwaukee & St. Paul have now been completed and contracts let to the General Electric Company for the electric locomotives, substation apparatus and line material, and to the Montana Power Company for the construction of the transmission and trolley lines. This initial electrification of 113 miles of main line between Three Forks and Deer Lodge is the first step toward the electrification of four engine divisions extending from Harlowton, Montana, to Avery, Idaho, a total distance of approximately 440 miles, aggregating about 650 miles of track, including yards and sidings. While this comprises the extent of track to be equipped in the near future, it is understood that plans are being made to extend the electrification from Harlowton to the coast, a distance of 850 miles, should the operating results of the initial installation prove as satisfactory as anticipated.

Map of Present and Proposed Electrified Divisions, C. M. & St. P. Ry.

The plans of the Chicago, Milwaukee & St. Paul are of especial interest, as this is the first attempt to install and operate electric locomotives on tracks extending over several engine divisions, under which conditions it is claimed the full advantage of electrification can be secured. The various terminal and tunnel installations have been made necessary, more or less, by reason of local conditions; but the electrification of this road is undertaken purely on economic grounds with the expectation that superior operating results with electric locomotives will effect a sufficient reduction in the present cost of steam operation to return an attractive percentage on the large investment required. If the anticipated savings are realized in the electric operation of the road, this initial installation will constitute one of the most important milestones in electric railway progress, and it should foreshadow large future developments in heavy steam road electrification. The success of electric operation on such a large scale will, at least, settle the engineering and economic questions that enter into the advisability of making such an installation, and will limit similar future problems to the means of raising the money expenditure required.

The first step taken towards electrification by the Chicago, Milwaukee & St. Paul was to enter into a contract with the Montana Power Company for an adequate supply of power over



Profile of Present and Proposed Electrified Divisions, C. M. & St. P. Ry.

the 440 miles of main line considered for immediate electrification. The precautions taken both by the railway company and power company to safeguard the continuity of power supply should guarantee a reliable source of power subject to few interruptions of a momentary nature only.

The Montana Power Company covers a great part of Montana

Great Falls, Mont., on the Missouri River. Site of a 60,000 K. W. Hydro-Electric Plant.

and part of Idaho with its network of transmission lines, which are fed from a number of sources and have a total power capacity, developed and undeveloped, of 244,000 kw.

The several power sites are interconnected by transmission lines, supported on wooden poles and operating at 50,000 volts for the earlier installations, and on steel towers and operating at 100,000 volts for later installations. Ample water storage capacity is provided in the Hebgen reservoir of 300,000 acre-feet, supplemented by an auxiliary reservoir capacity at the several power sites, which brings the total up to 418,000 acre-feet. The Hebgen reservoir is so located at the headwaters of the Madison river that water drawn from it can supply in turn the several installations on the Madison and Missouri rivers, so that the same storage capacity is used a number of times, affording an available storage capacity considerably greater than is indicated by the figures given. It would seem, therefore, in changing from coal to electricity as a source of motive power, that the railroad is amply protected in respect to the reliability and continuity of the power supply.

Due to the great facilities available and the low cost of construction under the favorable conditions existing, the railway company will purchase power at a contract rate of $0.00536 per

Avery, Idaho, Western Terminal of the Proposed C. M. & St. P. Electrification.

kilowatt-hour based on a 60 per cent. load factor. It is expected under these conditions that the cost of power for locomotives will be considerably less than is now expended for coal. The contract between the railway and power companies provides that the total electrification between Harlowton and Avery, comprising four engine divisions, will be in operation January 1st, 1918.

In order to connect the substations with the several feeding-in points of the Montana Power transmission lines, a tie-in transmission line is being built by the railway company that will permit feeding each substaton from two directions and from two or more sources of power. This transmission line will be constructed with wooden poles, suspension type insulators, will operate at 100,000 volts and will follow, in general, the right of way of the railway company except where advantage can be taken of a shorter route over public domain to avoid the necessarily circuitous line of the railway in the mountain districts.

The immediate electrification of 113 miles will include four substations containing step-down transformers and motor-generator sets with necessary controlling switchboard apparatus to convert 100,000 volt 60 cycle three-phase power to 3,000 volts direct current. This is the first direct current installation using such a high potential as 3,000 volts, and this system was adopted in preference to all others after a careful investigation extending over two years. The 2,400 volts direct current installation of the Butte, Anaconda & Pacific Railway in the immediate territory has furnished an excellent demonstration of high voltage direct current locomotive operation during the past year and a half, and the selection of 3,000 volts direct current for the Chicago, Milwaukee & St. Paul was due in a large measure to the entirely satisfactory performance of the Butte, Anaconda & Pacific installation.

The equipment for this road was also furnished by the General Electric Company, and a comparison based on six months' steam

On the Line of the C. M. & St. P., Between Three Forks and Piedmont.

and electric operation shows a total net saving of more than 20 per cent. on the investment or total cost of the electrification. These figures, of course, do not take into acount the increased capacity of the lines, improvement to the service and the more regular working hours for the crews. The comparison also shows that the tonnage per train has been increased by 35 per cent., while the number of trains has been decreased by 25 per cent., with a saving of 27 per cent. in the time required per trip.

SUBSTATIONS.

The substation sites of the Chicago, Milwaukee & St. Paul electrified zone provide for an average intervening distance of approximately 35 miles, notwithstanding that the first installation embraces 20.8 miles of 2 per cent. grade westbound and 10.4 miles of 1.66 per cent. grade eastbound over the main range of the Rocky Mountains. With this extreme distance between substations and considering the heavy traffic and small amount of feeder copper to be installed, it becomes apparent that such a high potential as 3,000 volts direct current permits of a minimum investment in substation apparatus and considerable latitude as to location sites.

The substations will be of the indoor type, transformers being three-phase, oil-cooled, and reducing from 100,000 volts primary to 2,300 volts secondary, at which potential the synchronous motors will operate. The transformers will be rated 1,900 and

Showing the Snowbound Country Traversed by the C. M. & St. P. Ry.

Freight Train Ascending Ruling Two Per Cent Grade Between Piedmont and Donald.

2,500 kv-a, and will be provided with four 2½ per cent. taps in the primary and 50 per cent. starting taps in the secondary.

The motor-generator sets will comprise a 60-cycle synchronous motor driving two 1,500-volt direct current generators connected permanently in series for 3,000 volts. The fields of both the synchronous motor and direct current generators will be seperately excited by small generators direct connected to each end of the motor-generator shaft. The direct current generators will be compound wound, will maintain constant potential up to 150 per cent. load and will have a capacity for momentary overloads up to three times their normal rating. To insure good commutation on these overloads, the generators are equipped with commutating poles and compensating pole-face windings. The synchronous motors will also be utilized as synchronous condensers, and it is expected that the transmission line voltage can be so regulated thereby as to eliminate any effect of the fluctuating railway load.

OVERHEAD CONSTRUCTION.

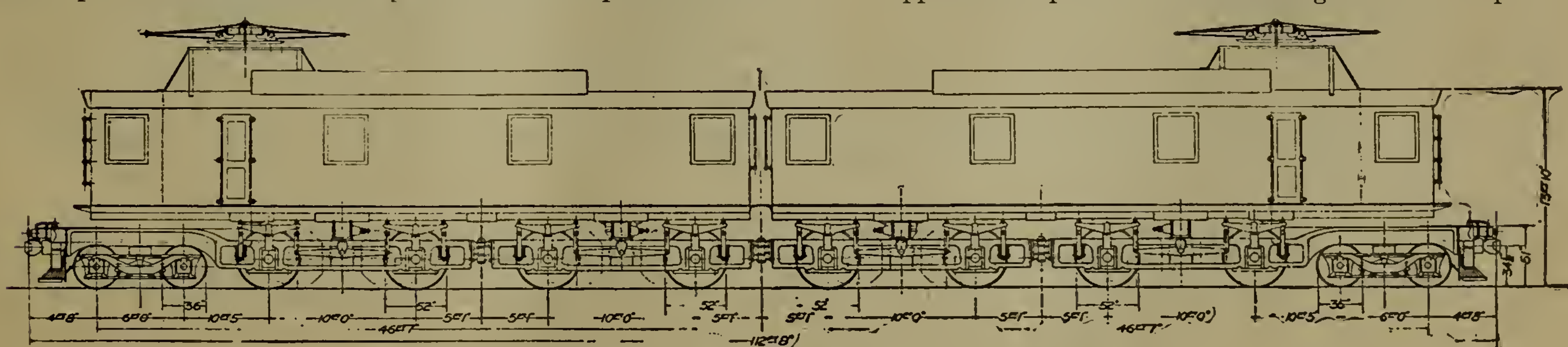
The trolley construction will be of the catenary-type, in which a 4/0 trolley wire is flexibly suspended from a steel catenary supported on wooden poles, the construction being bracket wherever track alignment will permit and cross-span on the sharper curves and in yards. Steel supports instead of wooden poles will be used in yards where the number of tracks to be spanned exceeds the possibilities of wooden pole construction. Poles for the first installation are already on the ground and thirty miles of poles are set. Work in this direction will be pushed with all speed and will be completed in the summer of 1915, ready for operation in the fall on the delivery of the first locomotives.

As the result of careful investigation and experiments, a novel construction of trolley will be installed, composed of the so-called twin-conductor trolley. This comprises two 4/0 wires suspended side by side from the same catenary by independent hangers alternately connected to each trolley wire. This form of construction permits the collection of very heavy current by reason of the twin contact of the pantograph with the two trolley wires, and also insures sparkless collection under the extremes of either heavy current at low speed or more moderate current at very high speeds. It seems that the twin-conductor type of construction is equally adapted to the heavy grades calling for the collection of very heavy currents, and on the more level portions of the profile where maximum speeds of 60 m. p. h. will be reached with the passenger trains having a total weight of over 1,000 tons. The advantage of this type of construction is due partly to the greater surface for the collection of current, but largely to the very great flexibility of the alternately suspended trolley wires, a form of construction which eliminates any tendency to flash at the hangers either at low or high speed. Including sidings, passing and yard tracks, the 113 miles of route mileage is increased to approximately 168 miles of single track to be equipped between Deer Lodge and Three Forks in the initial installation.

LOCOMOTIVES.

The locomotives to be manufactured by the General Electric Company are of especial interest for many reasons. They are the first locomotives to be constructed for railroad service with direct current motors designed for so high a potential as 3,000 volts. They will weigh approximately 260 tons and will have a continuous capacity greater than any steam or electric locomotive yet constructed. Perhaps the most interesting part of the equipment is the control, which is arranged to effect regenerative electric braking on down grades. This feature as yet has never been accomplished with direct current motors on so large a scale. The general characteristics as proposed are tabulated below:

Total weight	260 tons
Weight on drivers	200 tons
Weight on each guiding truck	30 tons
Number of driving axles	8
Number of motors	8
Number of guiding trucks	2
Number of axles per guiding truck	2
Total length of locomotive	112 ft.
Rigid wheel base	10 ft.
Voltage of locomotive	3,000
Voltage per motor	1,500
H. P. rating 1 hour, each motor	430
H. P. rating continuous, each motor	375
H. P. rating 1 hour, complete lomocotive	3,440
H. P. rating, continuous, complete locomotive	3,000
Trailing load capacity, 2 per cent. grade	1,250 tons
Trailing load capacity, 1 per cent. grade	2,500 tons
Approximate speed at these loads and grades	16 m. p. h.



Elevation of 3,000 Volt Electric Locomotive, C. M. & St. P. Ry.

The Chicago, Milwaukee & St. Paul, from Harlowton to the coast, crosses four mountain ranges: The Belt Mountains at an elevation of 5,768 feet, the Rocky Mountains at an elevation of 6,350 feet, the Bitter Root Mountains at an elevation of 4,200 feet, and the Cascade Mountains at an elevation of 3,010 feet. The first electrification between Three Forks and Deer Lodge calls for locomotive operation over 20.8 miles of 2 per cent. grade between Piedmont and Donald at the crest of the main Rocky Mountain divide, so that the locomotive will be fully tested out as to their capacity and general service performance in overcoming the natural obstacles of the first engine division.

The initial contract calls for nine freight and three passenger locomotives having the above characteristics and similar in all respects, except that the passenger locomotives will be provided with a gear ratio permitting the operation of 800-ton trailing passenger trains at approximately 60 m. p. h., and will, furthermore, be equipped with an oil-fired steam heating outfit for the trailing cars. The interchangeability of all electrical and mechanical parts of the freight and passenger electric locomotives is considered to be of very great importance from the standpoint of operation and maintenance.

The cab consists of two similar sections extending practically the full length of the locomotive. Each section is approximately 52 feet long and the cab roof is about 14 feet above the rail exclusive of the housings for ventilation. The trolley bases are about 5 feet above the roof owing to the unusual height of the trolley wire, which will be located at a maximum elevation of 25 feet above the rail. The outer end of each cab will contain a compartment for the engineer, while the remainder is occupied by the electric control equipment, train heater, air brake apparatus, etc.

MOTORS.

The eight motors for the complete locomotive will be type GE-253-A. This motor has a normal one-hour rating of 430 h. p., with a continuous rating of 375 h. p. The eight motors will thus give the locomotive a one-hour rating of 3,440 h. p. and a continuous rating of 3,000 h. p., which makes it more powerful than any steam or electric locomotive ever built. The drawbar pull available for starting trains will approximate 120,000 lbs. at 30 per cent. coefficient of adhesion.

Ore Train on the Electrified Butte, Anaconda & Pacific at Silver Bow, Crossing the Tracks of the Northern Pacific and C. M. & St. P. Ry.

Each motor will be twin-geared to its driving axle in the same manner as on the Butte, Anaconda & Pacific, the Detroit River Tunnel and the Baltimore & Ohio locomotives, a pinion being mounted on each end of the armature shaft. The motor is of the commutating pole type and has openings for forced ventilation from a motor-driven blower located in the cab.

The freight locomotives are designed to haul a 2,500-ton trailing load on all gradients up to 1 per cent. at a speed of approximately 16 m. p. h., and this same train load unbroken will be carried over the 1.66 and 2 per cent. ruling grades on the west and east slopes of the Rocky Mountain divide with the help of a second similar freight locomotive acting as pusher. Track provision is being made at Donald, the summit of the grade, to enable the pusher locomotive to run around the train and be coupled to the head end to permit electric braking on the down grade. In this case, the entire train will be under compression and held back by the two locomotives at this head end, the entire electric braking of the two locomotives being under the control of the motorman in the operating cab of the leading locomotive. It is considered that electric braking will prove very valuable in this mountain railroading; for, in addition to providing the greatest safety in operation, it also returns a considerable amount of energy to the substations and transmission system, which can be utilized by other trains demanding power. In this connection, the electric locomotives will have electric braking capacity sufficient to hold back the entire train on down grade, leaving the air brake equipment with which they are also equipped to be used only in emergency and when stopping the train. There is, therefore, provided a duplicate braking system on down grades, which should be reflected in the greatest safety of operation afforded and the elimination of a considerable part of break-downs, wheel and track wear and overheating, with consequent reduction in maintenance and improvement in track conditions.

With the completion of the remaining engine divisions, it is proposed to take advantage of the possibilities afforded by the introduction of the electric locomotive by combining the present four steam engine divisions into two locomotive divisions of approximately 220 miles length, changing crews, however, at the present division points. As the electric locomotive needs inspection only after a run of approximately 2,000 miles, requires no stops for taking on coal or water, or layover due to dumping ashes, cleaning boilers or petty roundhouse repairs, it is expected that the greater flexibility of the locomotive so provided will result in considerable change in the method of handling trains now limited by the restrictions of the steam engine.

The electrification of the Chicago, Milwaukee & St. Paul is under the direction of C. A. Goodnow, assistant to the president, in charge of construction, and the field work is under the charge of R. Beeuwkes, electrical engineer for the railway company.

RAILROADS AND COAL MINES CO-OPERATE TO PREVENT ACCIDENTS.

Coal mining companies are proving of real assistance to the Pennsylvania System in a campaign to end the practice of coal miners of packing dynamite and other explosives in trunks, which they check as baggage when they travel from one mine to another. Serious accidents have occurred as the result of explosions of dynamite in trunks and suit cases checked as baggage.

The Westmoreland Coal Company, one of the largest producers of bituminous coal in Pennsylvania, and the Susquehanna Coal Company, one of the principal anthracite companies, have announced that they will buy back from miners, when they leave their service, any explosives they may have on hand, paying the original price.

It has developed that one reason why coal miners, most of whom are foreigners, pack dynamite and other explosives in their trunks and other pieces of baggage is that when they move from one mine to another they do not feel they can afford to throw away any blasting material they may have on hand.

The railroad's rules against carrying explosives in trunks and other baggage are printed in foreign languages and posted at practically all mines, and it is thought that the regulations are known to most of the miners. If, therefore, the mine companies agree to buy back at the original price any extra explosives the miners may have, it is thought the practice of packing such materials in trunks will be eliminated to a large extent.

The rate decision is beginning to have a good effect. The main point is that this action of the commission signalizes a change not only in their policy but in the attitude of the public towards the railroads. Heretofore there has practically been no recognition of the interests of the roads.

THE MECHANICAL SIDE OF RAILROADING.*

By William Schlafge, Genl. Mech. Supt., Erie R. R.

About one hundred years ago the progress of the world in all lines of effort brought about a condition where commerce, particularly inland commerce, had outgrown the known and tried means of transportation to such an extent, that an arrest of development was imminent, unless new and adequate methods could be devised to meet the changed conditions of the times.

Then both in the old world, and in the new, the channels of commercial carriage were the waterways, natural and artificial, and the highways. The latter varied from crude, primitive pathways, through the newer and sparsely settled regions, and of severely limited unit load capacity, to the scientifically constructed roads, of the older and more populous communities, which, designed with that end in view, were correspondingly more economical and efficient.

Steam was receiving recognition as a practical aid to navigation and the day, when its perfected application would supplant sailing power, was in sight to wide awake observers. But on the land, domestic animals were still the main reliance as prime movers. It was in land carriage where the insufficiency of means was most keenly felt, and which called the loudest for relief. But in spite of the efforts of hopeful dreamers and hard working men of mechanical genius and of dauntless courage, to adapt steam to the purpose, the day seemed yet far distant when relief would come by that means. As usual history repeated itself, just as it does today, and about everybody scouted the idea as an impossibility and an idle dream.

But in every crisis, in every age, some commanding figure rises above his fellows and quietly, calmly takes the burden and meets the problem of the hour. This is remarked with such unfailing regularity throughout history that we have come to speak of the advent of such men as Providential.

Is there a new continent to be discovered, a Columbus appears. Are the liberties of a nation to be defended and preserved, a Prince of Orange or a Lincoln arises to guide its destinies. A Goethals is found to meet the supreme test of mighty constructive achievement and overcomes all obstacles, even the seemingly unconquerable forces of nature; and so, in the early part of the nineteenth century, the master mind of Stephenson harmonized and co-ordinated the diverse theories and accomplishments of his contemporary investigators, and gave to the world the steam locomotive as a practical agency of commerce. Nor does it detract from his just fame, to concede that another may have a better claim to be considered as the original inventor of the steam locomotive. It is fairly well settled that he made the earliest application of known principles, which produced a workable, successful locomotive of commercial utility. A mere passive academic knowledge of principles, or of truth, is of no avail unless applied. It is application to useful ends that counts.

Thus we see that railroads had their beginning in the fruits of mechanical genius and, after the passing of the century, that separates these pioneer efforts in locomotive design and building from the worthy accomplishments of today, we may still say that the mechanical side of railroading has retained its absorbing interest and its orginal relative importance.

The history of the development and progress of railroading may be pictured graphically in many ways; but it may be doubted if that wonderful story can be told more vividly, more convincingly, more accurately than by contemplating the evolution of the locomotive from Stephenson's "Rocket" to the latest Pacific type or triplex compound or, indeed, by tracing the growth of carrying vehicles from a unit, scarcely larger than an ordinary road wagon, to the seventy-five ton freight car.

If we are to analyze railroad operation it is obvious that we will find that each department has problems and troubles peculiar to itself. On the mechanical side the great problem, as to American railroads, is the care, inspection and maintenance of 2,500,000 freight cars, 56,000 passenger cars and 66,000 locomotives representing an investment estimated at three billion three hundred and fifty million dollars and calling for an annual maintenance charge estimated at $450,000,000. It might be remarked, in passing, that the latter sum would more than provide each year for a work of peace equal to the Panama Canal; but it would only finance the European war for about ten days.

Were all the cars and locomotives of American railroads coupled together, over two thousand miles of track would be required to hold them. They would considerably more than fill solid the main line double tracks of the Erie Railroad, from New York to Chicago or, on a single track, they would reach from New York to Denver.

It is not possible, nor even desirable, perhaps, to go into the details of mechanical operation to show the magnitude of the work involved; but a faint conception of it can be had by recalling that approximately one billion passengers and over one billion tons of revenue freight are carried per annum on American railroads. Carrying units must be kept in condition to transport this great volume of business in safety, to conserve both life and property, and locomotives must be maintained in condition to move it. The extent of this work to some degree is indicated by citing, as an example, a few essential parts of a freight car which, if in disrepair, may cause trouble ranging from an interruption of traffic, more or less serious, to derailment and loss of life or property.

Such parts are wheels, axles, journal bearings, brake beams, air hose and drawbars, of which there are twenty-eight items per car unit, or a total of seventy million important parts, on the entire freight equipment of the country, that must be watched every day to prevent disaster.

In addition to these principal parts, having to do with the safe movement of the car itself, there are innumerable parts of lesser importance which, if defective, may endanger the safety of the car and many others such as defective roofs, sheathing, floors and doors, projecting bolts and nails, which may cause damage to property entrusted to transportation.

Aside from the multitude of things, which self interest and ordinary prudence would cause the carriers to look out for, there are many duties of inspection and maintenance, imposed by the laws of the several states and of the United States, referred to collectively as safety appliance laws. These add to the burden and expense of mechanical operation. There are literally hundreds of parts on every car, a failure or absence of which, may cost the operating carrier a fine of one hundred dollars. There are a like number on every locomotive, which require the closest attention, to avoid trouble leading either to a fine or the compulsory withdrawal of the locomotive from service.

To meet the complex responsibilities of the mechanical side of railroad operation, and maintain the equipment in a state of preparedness demands, as in every other department of the business, a balanced and efficient organization, whose members shall be devoted to the work and sustained by the animated pursuit of a common purpose.

The usual staff organization of the mechanical department consists of a chief officer, styled superintendent or general superintendent of motive power, mechanical or general mechanical superintendent, superintendent of machinery, or other title, appropriate to the office. On the larger roads the chief mechanical officer, as a rule, is assisted by one or more deputies, bearing various titles, who have general authority and, sometimes, have direct supervision of the shops, thus standing between the shop organizations and the chief of the department. Not infrequently there is an officer charged with responsibility for the work of the car department, with the title of superintendent of car department, or master car builder. On the Erie there are three mechanical superintendents. One has general charge of all car work of the system. One is assigned to each grand division of the road, in direct charge of the locomotive shops and has concurrent jurisdiction, in a restricted sense, over car work in his territory. The other regular staff officers are a mechanical engineer, electrical engineer, engineer of tests, chemist, chief boiler inspector and general inspectors of various grades and diverse duties. The larger roads add to the above two general officers who are absolutely indispensable where

* A paper delivered before the Railroad Men's Improvement Association.

there is any pretense of practicing the higher phases of railroad economy, using that term in its scientific sence. These are an efficiency engineer who is in charge of shop costs and production, and frequently at the head of the piece work system, and an expert in locomotive economy, whose duty it is, to save fuel and look after the economical operation of the locomotive. On the Erie these officers are designated, respectively, as superintendent of piece work and apprentices, and superintendent of locomotive operation.

The chief officer of the shop organization is the division master mechanic, or shop superintendent, on the locomotive side and a shop superintendent, foreman of car repairs, or an officer having some other suitable title, at the car shops. The division master mechanic frequently has charge of all mechanical work on his division; but it is customary to have large car shops entirely independent of his authority.

The shop organization varies with the size of and importance of the shop. At a large shop there are usually a general foreman, an assistant to the general foreman who is in charge of shop costs and production, departmental foreman, inspectors, etc.

In the division mechanical organization special mention should be made of the engine terminal which, by reason of its functions, is not properly classified with shop operations, whether closely associated with them or not. The engine terminal is to railroads what the coaling station is to ships on the high seas. Nothing will paralyze traffic movement and demoralize operation quite as effectively as putting an engine terminal out of business, or to have it in charge of a man who is incapable of facing all emergencies, and overcoming everything, but the physically impossible. This is so well understood that we are accustomed to say, that engine house foremen like poets are "born not made."

Associated with the divisional organization are the road foremen of engines and the inspectors of locomotive service, called supervisors of locomotive operation on the Erie. The mechanical department has concurrent jurisdiction with the transportation department over these officials.

It has been shown that a strong organization is essential to good operation; but there are limits to what may be done by the best organization and the most devoted and diligent application, on the part of the personnel. This brings us to the consideration of shop and engine house facilities. A good organization may overcome, in a measure, the handicap of inferior, inadequate or obsolete facilities, but it can never supply their lack.

The change from wood to steel in car building calls for new facilities, adapted to repair steel cars; the increase in the size, and complexity, of the locomotive unit calls for larger roundhouses, improved engine terminal facilities, and for heavier and more improved machinery and appliances to handle and repair them. The needed facilities are scarcely installed when an insistent demand is made for their improvement, so rapid are the changes that make achievements of today, but stepping stones, for the greater achievements of tomorrow.

But the mechanical side of railroading produces no income, it sends no actual cash into the treasury regardless of what it may keep from going out. Its omission is to do its part to keep the instrumentalities of commerce in shape to earn revenue. Each passenger locomotive may earn approximately $3,700 and each freight locomotive $52,000 per annum, but the sad truth ever confronts the mechanical man, that from twenty to twenty-five per cent of all operating expenses is laid up against him. He is a good spender and he is always "broke." His stories, therefore, are apt to be of the hard luck variety, and they are received with the same cordial enthusiasm that a subscription paper, to buy the Kaiser a loving cup, would be received in London or, as the solicitation of a similar token of affection for King George would be received in Berlin.

The mechanical man makes up a modest program for a new roundhouse at one point; two or three modern coal and ash handling plants; a couple of new power plants; perhaps a new shop; a hundred new machines and a job lot of fifty thousand dollars worth of small tools and miscellaneous things regarded as useful in his business. When the hard pressed management makes a few minor revisions of his plans he cheerfully accepts the allowance, builds an extension to several stalls of the old roundhouse to house the big engines, puts new flues in the boilers of the much slandered power plants, gives the old shop a coat of whitewash inside, forgets the rest and, like a true railroad man, settles down to do business with what he has, as better men have done before him and will do after he has gone. After all, he reasons, there is something to be thankful for. If something had to be cut off, far better the improvements than his head. Then, if he is somewhat of a philosopher and given to rather fanciful speculation, he may occasionally dream, and even pray, that a certain high administrative body at Washington may get religion, because when men get religion, the hereafter is illuminated with a brightness never before realized and they hasten to make reparation for the wrongs and misdeeds done in their days of evil. He well knows that complete reparation would cause the improvements he recommended to appear in a different light, and might even make possible those bridges, the maintenance of way people have been after so long, and the ties and rails needed so badly.

One ancient good, but that has given way to enlightenment, is the old railroad apprentice system. In the old days, the average apprentice who served his time in a railroad shop, learned to operate the various machines and to repair locomotives, but he was rarely an all around mechanic. Little, if any, attention was given to his educational qualifications when he was apprenticed and, unless he had the ambition to attend night school or apply himself to self study, he usually lacked that knowledge of the principles of mechanics and of higher mathematics, which would fit him to extend his field of usefulness. Also the master was not particular, at all times, to concern himself about giving the novice the best opportunity to become a good all around journeyman. If the apprentice had special aptitude for certain work he was too frequently kept at it, instead of moving him about to afford a wider range of training.

Also certain details, like valve setting, air pump, lubricator, injector and tool room work were regarded somewhat in the light of trade secrets and the apprentice was fortunate who got any experience or knowledge of this work.

These unfruitful conditions were well known, but finally progressive thinkers came to the realization that the system was all wrong and that it was not beneficial to the master, the apprentice or to society, and out of these conclusions has grown a system of railroad apprenticeship and industrial education of the highest type.

Speaking of the apprentice course of the Erie Railroad as typical, I can say that the railroad apprentice today has every advantage to become a well rounded mechanic, and is given a basic technical education that equips him for the widest usefulness. In most cases the instructors are college graduates and are far better equipped to teach industrial education than many employed for that purpose, in high schools, trade schools and other places, where that branch is taught.

Contrary to the practice under the old system, the apprentice is now carefully and fully instructed in the very things that, formerly, were withheld from him, and extreme care is taken to make him proficient in every detail of the art. Not only is the course free but the apprentice is paid for his time while under instruction. The results have been most gratifying.

Railroad work, beyond question, is very interesting. It is frequently remarked, that there is something about the life which attracts and holds men, with greater force, than its material rewards. If we seek far enough the reason will be found in that lofty, and exacting attribute, of human nature which withholds contentment and satisfaction from the normal man unless he can feel himself a part of the world's real work. It is not ambition, for ambition is not always worthy, and sometimes is even sordid and mean. It is rather that vital and deathless something of soul life, deep rooted in character, that gives off only inspiration and courage. It is that same force that sustains and disciplines real

men to find their chief reward in work well done, and in efforts well directed to ends worth while.

Railroad work surely has a high place in the activities, which most benefit mankind, and it is not strange that men should find the field attractive. Recalling our subject for this evening, it is believed that the mechanical side of railroading is, at least, as interesting, as attractive and as fascinating as any other branch of the service.

But I would not have you get the impression that I am speaking as a mechanical man. Rather would I have you think of me as a railroad man. I have scant tolerance for departmental distinctions. Departmental lines are very proper, and necessary, to fix the lines of responsibility and for the orderly and effective conduct of business; but no further. It is trite to say that all energies, that are not directed toward the ultimate and legitimate ends of any business, are wasted or at least impaired. That end in the railroad business is to sell transportation at a decent profit, and everything which diverts energy, that the business is taxed to create, from that object is a thing to be weeded out. This thought may be illustrated by picturing a wide stream in whose course, at a certain point, it must pass through a long narrow gorge. On the upstream side the waters are collected, by various tributaries, from hundreds of square miles of drainage area. The stream gains in volume until, at the narrows, the waters pile up and develop a tremendous, concentrated energy of well nigh resistless force, capable of being transmuted to the untold benefit of mankind. On the down stream side the waters spread out again into a wide, placid and, perhaps, sluggish stream as if tired by their demonstrations of energy passing through the gorge. The one shows the cumulative effect of the concentration of energy; the other of its dissipation.

Those who accustom themselves to see departmental work in capital letters, failing to co-ordinate their relations with the general interests of the business, are in danger of acquiring a perspective like that of the fly in the fable. You will recall that a fly who had perched himself on the axle of a chariot became much puffed up by what he fondly believed to be his ability to raise so much dust. In how much more kindly esteem would history regard this fly had he been willing to share his dust-raising glory with the chariot wheels and the horses. The fly was afflicted with a distorted point of view. Also he lacked generosity and a sense of humor.

We all preach about co-operation but constructive evidence of its practice does not equal the noise we make about it. The word co-operation, like efficiency and other mouth-filling terms, is rattled about the country like a pebble in a tin can. Many know what constructive team work is, a few practice it, but the majority merely talk about it, and look wise.

In 1878 there was widespread discussion about the resumption of specie payments. Much speculation was indulged as to whether it could, or could not, be done, and many predictions were made of the dire calamities that would follow an attempt to do it. John Sherman said it could be done and he quietly, and simply, announced that on a certain date the government would pay its obligations in gold. That settled the matter. The same decisive action is all that is needed to effect real co-operation, and co-ordination of purposes, in railroad work and, as Sidney Smith said, apropos of the proposition to build a wooden walk around St. Pauls, "If we lay our heads together the thing is done."

As a parting thought, following much that I fear has been tedious rather than instructive or entertaining, let me urge that a worthy ambition, diligence and industry are the price of success and the field is open. Success is a relative term and when one achieves a goal, approaching the ultimate limits of his capabilities, he has done well notwithstanding that he may not fill the world with his fame or receive its applause. In the words of one of the greatest thinkers of all time:

"He that seeketh to be eminent among stable men hath a great task, but that is ever good for the public, but he that plots to be the only figure among ciphers is the decay of a whole age."

ASSIGNED AND POOLED ENGINES.*

By T. C. Donaldson, Engineer.

The engineer or fireman who is interested in his work and anxious to keep off the failure sheet will tell you, "Give me a regular engine in preference to the extra list which is the pool." If the engine is not in as good shape as it should be when he gets it, the engineer will get busy right away, and try to improve conditions. He will look after the adjustment of the driving box wedges (the foundation of his work), and if he cannot get them properly adjusted in the engine house he will do it himself; keep rod brasses properly keyed up, look after the boiler attachments, see that air pump governors are properly adjusted so that air hoses will not be so liable to burst when carrying high pressure, on designated grades. In fact, the interested engineer will look after all the details of the engine and try and keep it out of the shop as long as possible. The interested fireman is also satisfied when he is assigned to a regular engine and in nearly every case he will get busy with the engineer and try to put things in working order. He will take care of his firing tools and other equipment that he handles, such as cab lamps, lanterns, flags, etc., while the engine is on the road, and on arrival at terminal will put them away, carefully treating them as if they were his own.

This engine crew will work together in hauling the train over the division; the engineer will handle the reverse lever, throttle and injector in a manner that will enable the fireman to maintain an even pressure on the boiler, thereby making the required time and keeping the flues dry; the fireman will do his best to help him get results by keeping the pointer of the steam gauge as near the 200 mark as possible, manipulating the front end damper to keep the safety valves quiet, thereby saving fuel. These men will do better work and, I believe, the company will get better results because the men have regular engines and, being satisfied, will take good care of them. On the other hand, put these men in the pool and see how long they will remain satisfied and maintain the interest they had in their regular engines. It is surprising to note the apparent indifference that exists in the present generation, and I am afraid it would become a case of environment with the engineers and firemen.

The average extra man of today will take good care of a regular man's engine when the regular man lays off, and leave it in as good condition as he finds it, but what will he do with an extra engine, a "Nobody's Claim," as we call them? He will leave it in the same condition as he finds it, which is not always very good, simply because the engine is pooled and no one is interested in it. The engineer will look her over at the end of the run, go to the engine house and report "set up wedges," "key up rod brasses," "engine pounding badly," "cylinder or valve packing blowing," "stop steam leaks in cab," etc., and probably wind up by saying "engine unfit for service."

The fireman will have his overalls under his arm, his dinner pail in his hand ready to jump off before the engine comes to a stop on ash pit track, paying no attention to cab lamps or other tool equipment, and the tool checker is lucky if he finds all of it; the number of fire rakes and coal picks gathered up recently by section men would lead one to believe that he does not.

The engine house foreman will go over the engineer's work report and figure out how much he can do in the limited time he has to do the work in. If he doesn't happen to be in the office when the work is reported he is not sure which item is of most importance, and the pooled engineer has gone home. He cannot do all the work this trip and the chances are that the pooled engine will go out with some important piece of work undone. Not so with the regular engineer; he is never in such a hurry that he can't hunt up the foreman if he wants some particular piece of work done and explain conditions to him and if all the work that is reported can not be done, the most important will be done. In this way the engine receives proper care and very seldom has a failure and the officials of the transporta-

*From the *Buffalo, Rochester & Pittsburgh Magazine.*

tion and mechanical department are satisfied with the performance of it.

I have worked with both classes of men on the road, have handled their work reports in the engine house for years and have come to the conclusion that conditions are smoother with the regular engine and firmly believe that year in and year out the engine with a regularly assigned crew will make more miles at less cost than the pooled engine.

A Reply by F. A. Parker, in Rock Island Employes' Magazine.

The article in the August, 1914, issue of the R. R. & P. Employes' Magazine, entitled "Regularly Assigned Engine Crews Versus the Pool," voices the ideals dear to the heart of every operating man. Everything Mr. Donaldson has said is true, and many more things from the train dispatcher's viewpoint could also be said in amplification of his views in favor of assigned engines. In substance, the assignment of engines to regular crews is nothing short of inaugurating the "Hine System" in the mechanical department, as it puts an assistant master mechanic on each machine.

So strong are these convictions that we are liable to lose sight of making the best of conditions which forbid regular assigned engines.

To make sure of the right trail, let us begin with a simple little matter; suppose that you were the owner of a taxi line in, say, Chicago. You took over this business in a dull season of the year. Your equipment consisted of your own machine shop in connection with your garage. You had twenty taxis valued at $2,500 each. Your business was not so heavy but what twenty chauffeurs working per your agreement with them twelve hours each day, could handle with ease. You saw the same advantages Mr. Donaldson does in assigning a regular chauffeur to each taxi, in the hopes (and no doubt the realization) that he would take a special pride in the machinery of his charge. He would keep it clean and attractive, avoid spotting the tires, and above all would show you that he was trying to blow up less gasoline than the "other fellow."

All of which has a tendency to advertise your business, reduce your machine shop expense and take a slap at the Standard Oil Company, of whose stock you are probably short.

Mark, now, you have agreed to work these chauffeurs not over twelve hours, including meals and lunches, per day. You will demand and be granted the decision that you are a level-headed business man. In fact, your arrangement of your men has every indication of it.

Now, as a generally prosperous season in all lines of trade advances, your business steadily increasing abreast with the times, you find that your twenty machines at twelve hours per day cannot meet the demands. In fact, your business has increased forty per cent, which, of course, would require your chauffeurs to remain on their machines twenty hours per day, or eight hours longer than you have agreed. This won't do and you say, "well, if I buy eight more of these $2,500 taxis my chauffeurs can handle forty per cent more business." Eight machines at $2,500 each is $20,000. The interest on this investment at six per cent is $1,200, and the depreciation is $5,000 more. Forget the depreciation beyond knowing it's there and remember the $1,200 per year, $100 per month, interest on the investment of eight more machines.

You then size up the business and note this rush will only last for three months and you are not financially able to spend $20,000 to secure the doubtful returns on three months' business. You again reason that by pooling your twenty machines among twenty-eight chauffeurs working ten hours each you will have increased the efficiency of your twenty machines the desired forty per cent. Each machine then stands at rest an average of four hours each day for necessary cleaning and repairs.

As a visible gain per month for the pool installed for the three months, or one-fourth of a year, credit yourself a third of $1,200, or $400 per month.

Now, then, $400 per month will place in your machine shop an inspector, two machinists and two car cleaner apprentices, the inspector to keep a record on the gasoline consumption, the repairs, spotted tires, and know that the work reported is done.

All this you will insist on and spend the $400 per month freely to tide you over this rush of business and avoid that staggering depreciation figure which applies to an auto.

Of course, you say those eight autos could be tied up nine months of the year, and lessen the depreciation. This gives you a bright thought in connection with the other twenty the balance of the year. Why not lessen depreciation by tying up eight of them and pooling the remaining twelve among twenty chauffeurs?

Now, if you will add one cipher to all monetary figures mentioned you have the case of the railroad company. The question is would you, as a railroad owner, buy and maintain eight more engines than you need, when, by spending half or a quarter of the interest on the investment obtain the same results? As a further question after your fair-minded answer, can you as an engineer afford to neglect a company's pooled engine any more than if assigned to you? Can you as a fireman waste your muscle to shovel any more coal into a pooled engine than one you are assigned to?

After all, is not the "assigned engine" idea a mere sentimental ghost? Don't you think that if you start preaching loyalty to the rest of the boys in behalf of the company's pooled engines you can bring about that same loving regard for a pooled engine as you have for an assigned?

By a Ripleyism, what's the difference between the number on the cab between friends?

RAILROAD NIGHT, A. S. M. E.

The Chicago section of the American Society of Mechanical Engineers held its second meeting of the year at the LaSalle Hotel on January 8, the meeting being designated as railroad night. A dinner was held at 6:30 and speaking commenced promptly at eight o'clock.

R. M. Ostermann, assistant to the vice-president of the Locomotive Superheater Co., was the first speaker, and with the aid of lantern slides he outlined the essential features of the superheater and described their application and use. Mr. Ostermann's paper was responded to by Robert Quayle, general superintendent of motive power of the Chicago & North Western, who handled the subject from the standpoint of the railway man. He said that his enginemen were very anxious to get superheater engines on account of their efficiency and ease of handling. The superheater has also proved very successful on switching engines. A switch engine which formerly had to go for water at 10:30 A. M. could with the superheater run until 2:00 P. M. Mr. Quayle stated that they had one or two pyrometers installed and that they were a great help to the man on the engine.

Clement F. Street, president of the Locomotive Stoker Co., read a paper on locomotive stokers, in which he outlined the growth in size of locomotives and railway rolling stock, and brought out the point that an increase in the power of locomotives was now limited by the inability of the firemen to supply enough coal. He predicted that the day would come when the stoker would be the accepted thing on all locomotives. H. T. Bentley, superintendent of motive power of the Chicago & North Western, said that what experience he had had with the stoker had not been entirely satisfactory and that they had not found them necessary with an engine equipped with a good coal pusher. Willard A. Smith, president of the *Railway Review*, gave a very interesting and instructive address on present-day problems in railway economics. Among the points which he brought out was that although the size of locomotives and cars has increased greatly, a smaller percentage of this increased capacity was being used. In conclusion he urged the establishment of a bureau or commission, to have as its object the working out of the various problems which confront roads from time to time. With such an institution any road could obtain help from it at will, much as the farmer now obtains advice from the department of agriculture. Dr. W. F. M. Goss made a few remarks, concluding the meeting.

Oxy-Acetylene Welding for Boiler Repairs

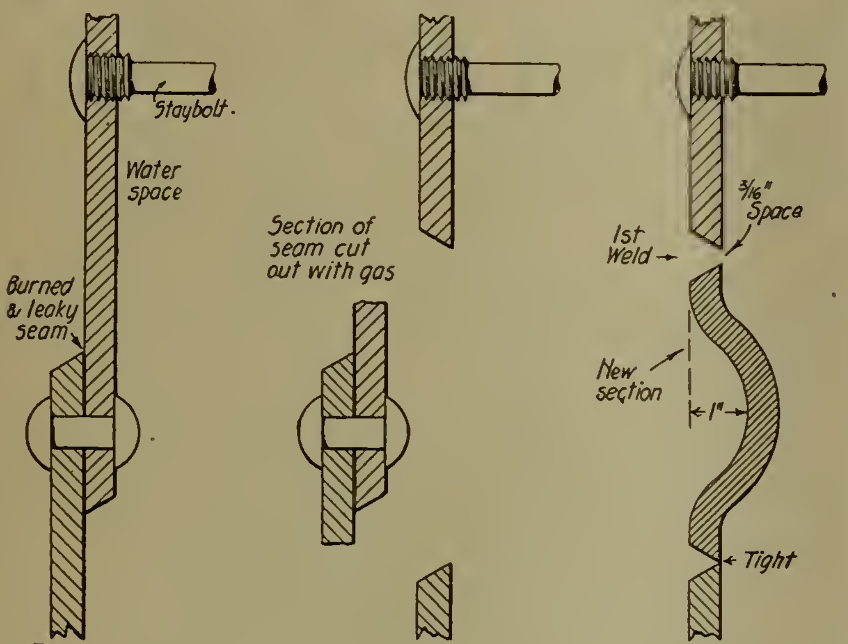
By A. A. Masters, Genl. Fmn., Delaware & Hudson, Watervliet, N. Y.

Realizing that a considerable saving could be made with oxy-acetylene welding in connection with boiler repairs, various experiments were tried out in order to ultimately obtain the best results.

A considerable number of partly or wholly inclosed patches were applied in the usual way, that is without any unusual provisions for contraction. Nearly all of these patches failed at one time or another due to the excessive strains set up in the boiler after the last weld was finally made.

To find out just where these strains were we trammed the boiler outside of the patches before welding. After welding was completed and in trying our tram marks we found a shrinkage of from one-eighth to one-quarter of an inch due to contraction in cooling, showing that by this method we had set up very considerable strains in the boiler.

The class of fire-box repairs that we have to contend with are parts of throat sheets, flue sheets, fire door sheets, and side sheets, at the point where sheets were riveted together. Also the



Method of Applying Sections to Firebox by Oxy-Acetylene Welding.

horizontal seams along the sides of fire box, which are constantly becoming burned and leaky.

Formerly under conditions of this kind the remedy was to apply a new fire box. To eliminate this and to successfully apply sections to the fire-box without renewing the entire fire-box we developed the method shown in the illustrations. These sketches show the method of applying a patch along the seam.

The crimp in the sheet is the method we finally adapted as a successful way of getting around the contraction. This crimp is now applied to all wholly or partically inclosed patches wherever patching is necessary in the fire-box, and in every case, if properly welded, no trouble develops later. The weld is first made along one side, then in starting to weld the second side the crimp is heated at the same time and with the same torch. The boiler when cooling pulls out a large amount of this crimp thus providing for the necessary contraction and relieving the strain on the boiler.

A patch applied with crimp of this kind, trammed before and after welding, gives no variation at the tram marks, showing that no undue stress exist.

In applying a section to the throat sheet or fire-box sheet crimps are applied to both vertical sides of the sheet. The top is first welded and then the sides, at the same time heating the corrugation.

The results of this method are that we have been able to cut the application of new fire-boxes, eighty per cent.

We weld all sheets together in fire door holes, eliminating all patch bolts and rivets and when necessary weld sections of flue sheets, welding the section of flue sheets together first, then laying up the sheet to the shell and driving the rivets at the last operation. We have been able to effect a great saving along nearly all lines of boiler work.

However, we have found it best to watch all operations and check the cost as it is somewhat misleading to observe acetylene gas welders working alone doing the same work in the same or less time than it takes two boilermakers and helper and rivet heater to perform.

However it must be born in mind that unless the time of the welder is less than the time required by the gang of boilermakers to complete the work there is no saving, as the welder's time plus the expense of running a torch is about equal to the expense of the two boilermakers, helper and rivet heater.

Another feature in connection with the acetylene gas welding in connection with boiler work is, generally speaking, the reduction of time necessary to complete a certain piece of work with the use of gas over that required by the other methods.

That is, if it was possible to make a reduction in the time required on all operations of one-half as is the case with the use of the new method of welding this would simply mean doubling the output.

As an illustration of the possible saving comparing the new and old ways, the following are figures on boiler repairs given engines 535 and 552:

NEW SIDE SHEETS APPLIED TO CROWN SHEET—ENGINE 535.

Oxy-Acetylene Welding.

Operators' rate	37c pr. hr.
Length of seams (9' each)	18 ft.
Thickness of plate	3/8 ft.
Opening at bottom of sheets	3/16 ft.
Size of head used on torch	No. 10
Pressure	30 lbs.
Actual time welding torch was burning	6 hrs.
Time charged by operator, 10 hours @ 37c	$ 3.70
Oxygen used, 362.5 cu. ft. @ .225c	$ 8.16
Acetylene gas used, 180 cu. ft. @ .007c	$ 1.26
Welding iron used, 11 lbs. @ 13c	$ 1.43
Total cost for welding 18 ft	$14.55
Cost per foot for welding	$ .808
Number of feet welded per hour while torch burning	3
Average feet welded per hour	1.8
Oxygen used per hour while torch burning	60.4 cu. ft.
Acetylene used per hour while torch burning	30 cu. ft.
Welding iron used per foot	61 lbs.

Old Way.

Removing and renewing 54 staybolts above seam @ 40c each	$21.60
Riveting seams, 20 hours @ $1.34	$26.80
Calking seams, 4 hours @ 37c	$ 1.48
Rivets, 31 lbs. @ .037	$ 1.14
Total old way	$51.02
Total new way	$14.55
Saving new way	$36.47

HALF DOOR SHEET—ENGINE 535

Oxy-Acetylene Welding.

Operators' rate	37c pr. hr.
Total length of welds	7'6"
Thickness of material	3/8"
Opening at bottom of grove	3/16"
Size of head on torch	No. 10
Pressure	30 lbs.
Time charged by operator 5 hours @ 37c	$ 1.85
Oxygen used, 300 cu. ft. @ .0225c	$ 6.75

Acetylene gas used, 150 cu. ft. @ .007c	$ 1.05
Welding iron used, 6 lbs. @ 13c	$ .78
Total cost for welding 7 feet 6 inches	$10.43

Old Way.

Removing and replacing 12 stay bolts @ 40c	$ 4.80
Riveting 10 hours @ $1.12½	$11.25
Rivets, 6 lbs. @ .037c	$ .22
Calking seams 2 hours @ 37c	$ .74
Total, old way	$17.01
Total, new way	$10.43
Saving new way	$ 6.58

SUMMARY—ENGINE 535.

Cutting, new way, 22′ 6″ @ $1.55 per ft	$ 3.49
Cutting, old way, 22′ 6″ @ 27c per ft	$ 6.075
Saving new way cutting	$ 2.585
Cost for welding, new way	$24.98
Cost for doing the same work, old way	$68.03
Saving new way welding from old	$43.05
Total cost, old way	$74.105
Total cost, new way	$28.47
Saving new way	$45.635
Time required old way	5 days
Time required new way	1.6 days
Saving of time new way	3.4 days
Oxygen used per foot of weld	26 cu. ft.
Acetylene used per foot of weld	1.29 cu. ft.
Iron used per foot of weld	.66 lbs.
Av. cost per foot for welding, including labor	.98 cents

CUTTING 35′ OF ⅜″ PLATE IN FIRE-BOX—ENGINE 552.

Oxy-Acetylene.

Used No. 1 head with 75 lbs. pressure	
Operator's rate	.37c pr. hr.
Time charged by operator, 2 hours @ 37c	$ .74
Actual time torch was cutting	1 hr.
Oxygen used, 200 cu. ft. @ .225 per ft	$ 4.50
Acetylene used, 25 cu. ft. @ .007 per ft	$ .17
Total cost for cutting 35 feet. ⅜″ thick steel plate	$ 5.41
Cost per foot for cutting (about)	$ .20

Old Way.

Labor of 1 boilermaker 22 hours @ 37c per hour	$ 8.14
Compressed air, 21 hours, @ .06c per hour	$ 1.26
Oil for air hammer	$ .05
Total cost old way	$ 9.45
Total cost new way	$ 5.41
Saving new way	$ 4.04

SUMMARY—ENGINE 552.

Oxygen used per foot of cut	5.7 cu. ft.
Acetylene used per foot of cut	.7 cu. ft.
Feet run per hour while torch burning	35 ft.
Av. cost per foot for cutting, including labor	.20 cents

PACIFIC TYPE LOCOMOTIVES, D. & H. CO.

Ten large anthracite burning Pacific type locomotives have recently been delivered to the Delaware & Hudson Company by the American Locomotive Company. These are the first locomotives of this type to be used on this road; the heavy passenger service formerly being handled by ten wheelers.

The anthracite burning ten wheelers have a total weight, engine and tender, of 313,900 pounds, the tenders having a capacity of 7,000 gallons of water and 12 tons of coal. With a driving wheel 69 inches in diameter, a steam pressure of 200 pounds and cylinders 21″x26″, they deliver a tractive power of 28,300 pounds. The new Pacifics have a total weight, engine and tender, of 460,100 pounds, the tender having a capacity of 8,000 gallons and 14 tons. With a driving wheel 69 inches in diameter, a steam pressure of 205 pounds and cylinders 24″x28″, they deliver a tractive power of 40,730 pounds. This is an increase of 46.6 per cent in weight and 44 per cent tractive power.

A passenger engine necessitates ample boiler capacity. The following comparison of the boilers of the new Pacifics and the older ten wheelers fully demonstrate the advantage of the new engines where sustained capacity is required:

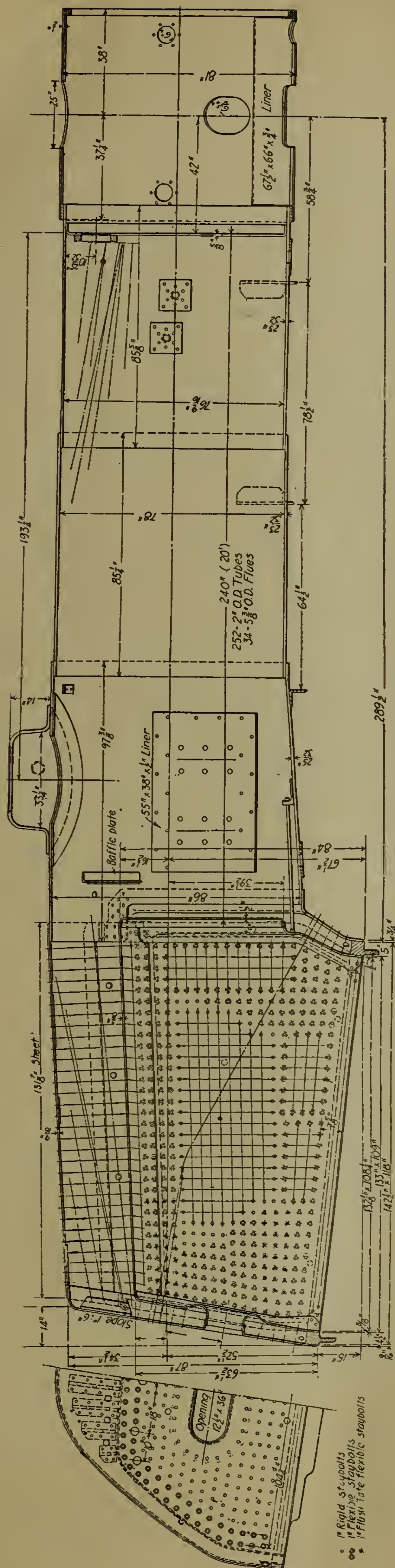
		Pacific	Ten Wheeler
Grate area	sq. ft.	99.3	84.9
Heating surface, tubes	sq. ft.	2,627	2,406
Heating surface, flues	sq. ft.	952	
Heating surface, fire brick tubes	sq. ft.	40	78
Heating surface, firebox	sq. ft.	277	178
Heating surface, total	sq. ft.	3,896	2,662
Superheating surface	sq. ft.	796	

Comparing the equivalent heating surface, which includes 1½ times the superheating surface, we have 5,090 square feet for the Pacifics as against 2,662 square feet for the ten wheeler, or an increase of 91.3 per cent.

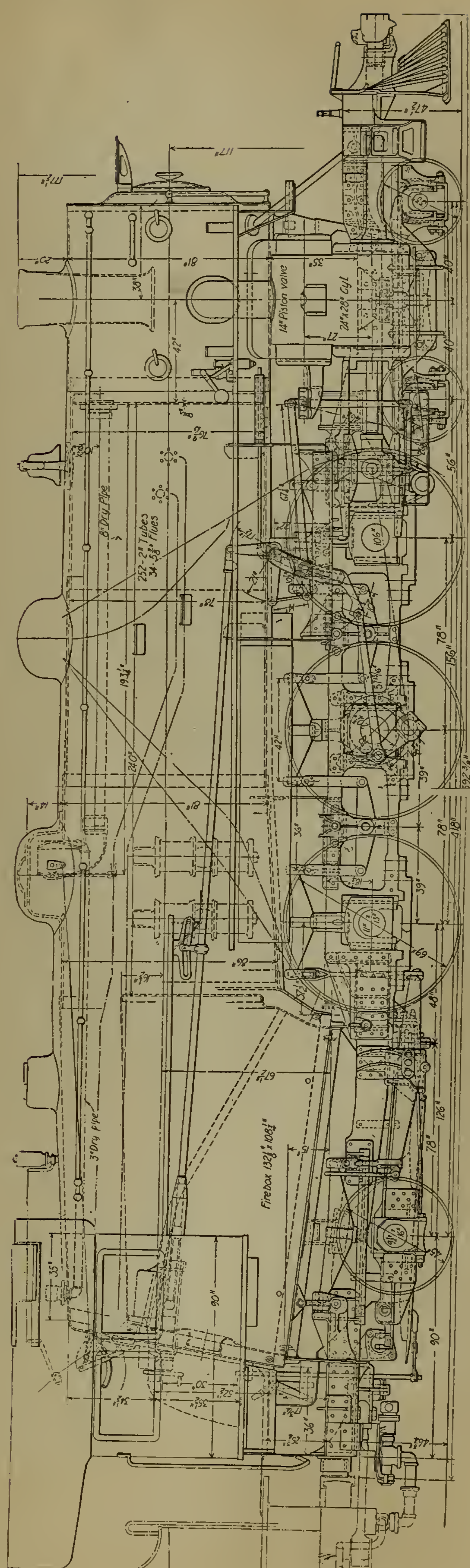
According to the method of boiler proportioning used by the American Locomotive Company, these Pacifics have 110 per cent. boilers. In a general way, a boiler will have ample steam making capacity if proportioned by this method for 100 per cent, but it has been proven that the boiler capacity cannot generally be made too large within the permissible limits of weight. It has been shown by numerous tests, especially by Dr. Goss' investigations, that such increase in boiler capacity makes for considerable economy in the use of fuel and steam. For passenger service, it is advantageous to make the boiler over 100 per cent when possible.

This design was developed by the mechanical department of the Delaware & Hudson in co-operation with the American Locomotive Company. Interesting details are the Schmidt superheater, brick arch, screw reverse gear, extended piston rods, long main driving box, Economy engine truck, Economy tender trucks, Economy pipe clamps, Economy radial buffer, and a speed recorder. Vanadium steel was used in the main frames, driving elliptic springs, engine truck elliptic springs and the tender truck elliptic springs.

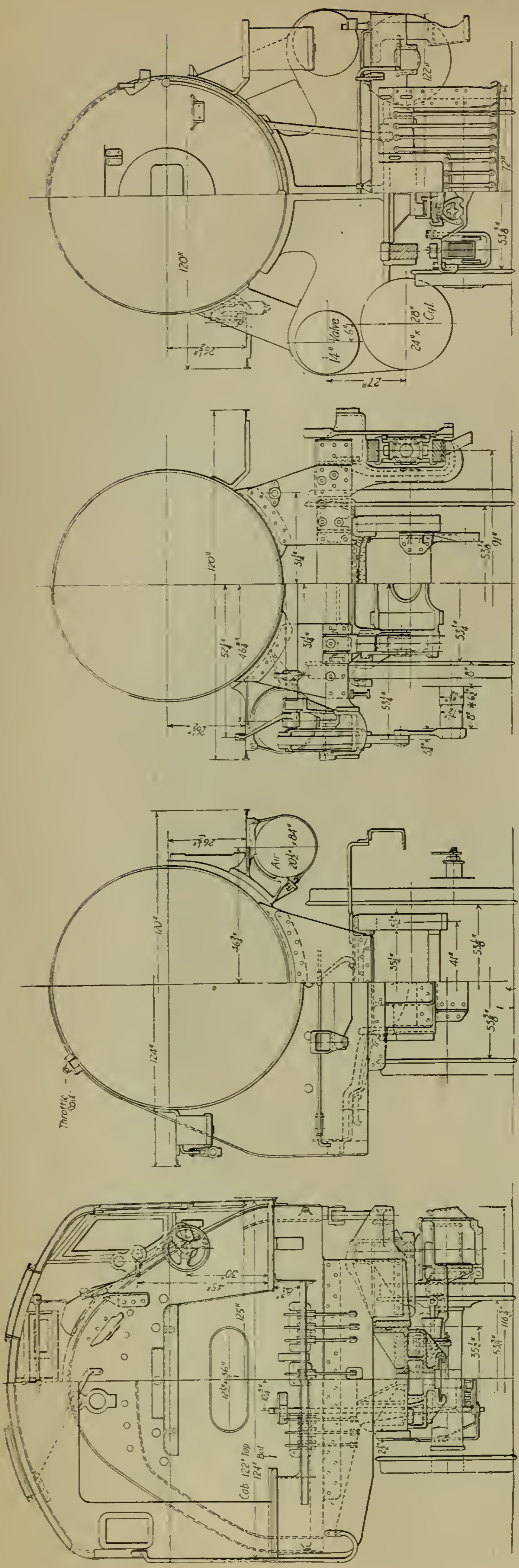
Pacific Type Locomotive, Delaware & Hudson Co.



Section of Boiler, Pacific Type Locomotive, Delaware & Hudson Co.



Elevation, Pacific Type Locomotive, Delaware & Hudson Co.



Cross Sections, Pacific Type Locomotive, Delaware & Hudson Co.

The principal dimensions and ratios are as follows:

Gauge	4'-8½"
Fuel	Anthracite
Cylinders	24"x28"
Factor of adhesion	4.59
Wheel base, driving	13'-0"
Wheel base, total	34'-10"
Wheel base, engine and tender	70'-4¼"
Weight in working order	293,500 lbs.
Weight on drivers	191,000 lbs.
Weight on trailers	55,000 lbs.
Weight on engine truck	47,500 lbs.
Weight of engine and tender	460,100 lbs.
Boiler pressure	205 lbs.
Firebox, length	132⅛"
Firebox, width	108¼"
Firebox, thickness of crown	⅜"
Firebox, thickness of tubes	½"
Firebox, thickness of side and back sheets	⅜"
Crown staying	Radial
Tubes	Charcoal iron
Tubes, number and size	252; 2"
Tubes, length	20'-0"
Heating surface, tubes and flues	3,579 sq. ft.
Heating surface, firebox	277 sq. ft.
Heating surface, arch tubes	40 sq. ft.
Heating surface, total	3,896 sq. ft.
Superheater surface	796 sq. ft.
Grate area	99.3 sq. ft.
Wheels, driving, diameter outside tire	69"
Wheels, engine truck, diameter	33"
Wheels, trailing truck, diameter	45"
Axles, driving journals, main	11"x22"
Axles, engine truck journals	6½"x12"
Axles, trailing truck journals	9½"x16"
Axles, tender truck journals	6"x11"
Tank style	Water bottom
Tank, capacity	5,000 gal.
Tank, capacity, fuel	14 tons
Valves	Piston

THE BOY ENGINEER.

Baby's toy engine is silent and still,
The railroad is tied up and baby is ill;
No express or baggage is shipped off by rail,
The through freight is side-tracked and also the mail;
No noise from the roundhouse; all out of repair,
There is no conductor to take up the fare,
And mother sits by, in whose eye there's a tear,
While she prays for the life of the boy engineer.

No shriek from the whistle, no sound from the bell;
No brakeman on duty, the stations to yell.
The road's in disorder and blocked is the main,
There's no rush nor rattle nor roar of the train;
The yards are all plugged, and a sad sight to view;
For tucked up in bed is the whole of the crew,
While mother sits up with a railroader dear,
Who is brakeman, conductor and boy engineer.

No yellow lights burning to signal trains, slow;
No green lights a-gleaming, to spell let her go;
No red light shows danger, when tracks are not clear,
For sick and in bed is the boy engineer.

—Hugh Burns, in *L. F. & E. Magazine.*

The Valley & Siletz is preparing to construct 10 miles of railroad in the spring. R. L. Donald, Northwestern Bank building, Portland, Ore., is manager.

FACTORS IN HARDENING TOOL STEEL.*

By John A. Mathews and Howard Stagg, Jr.

The phenomena of carburizing iron and of hardening it by quenching have been known for many centuries, yet the explanation of hardening steel has not yet been given to the satisfaction of all. Many theories have been advanced and each has its adherents, but one can scarcely say that any generally accepted theory or explanation exists. As recently as this year, two very interesting new theories were advanced at the May meeting of the Iron and Steel Institute of Great Britain.

In what follows we are not so much interested in the theories as in the practice of the art of hardening and tempering tool steel, and we shall confine our attentions to carbon steels, together with some consideration of so-called special steels containing various alloys, usually below 3 per cent. We shall not discuss high-speed steels, nor the many low-carbon alloy steels, primarily of value ou account of their tensile qualities, but also, in many cases of limited value for tools, especially those used for hot work. In this way only can we hold either the paper or the discussion within reasonable limits. We shall consider the subject, also, from the basis of sound well-worked materials and shall not consider the influence of defects, such as pipes, seams, bursts, laps, burning, etc. The hardening operation itself will give sufficient scope for our thought and attention.

Tool steels are included within the range of 0.60 to 1.50 per cent carbon, but not less than 90 per cent of them fall within carbon limits of 0.75 to 1.35 per cent. They are usually made by the very old crucible process or the very new electric processes, and just now there is considerable discussion as to the relative merits of these methods. As the writers are among the few men in the world who have had practical experience with both processes, we will refrain from discussing their respective merits at the present time to leave a free field for partisans. It is hardly necessary to remark that no mere process is a guarantee of quality; it takes brains, plus a process, to succeed in almost any line of manufacture. This is particularly true of tool steel, which is subjected to so many operations between the melting and the selling stage.

Carbon forms at least one definite compound with iron, Fe_3C, known as cementite. This is the hardest constituent in steel. Cementite exists in annealed steel associated with a perfectly definite quantity of iron, or ferrite, as it is metallographically known. This definite relation between ferrite and cementite yields the constituent pearlite, in which the cementite and ferrite may exist in a laminated or a granular condition. This aggregate contains a definite percentage of carbon, 0.89 per cent, and steel containing 0.89 per cent carbon in its normal condition, is found to consist of nothing but pearlite when examined microscopically.

In steel containing less than 0.89 carbon the cementite associates with sufficient ferrite to form pearlite, and leaves the excess ferrite free in distinct microscopic grains or crystals. On the other hand, if the steel contains above 0.89 carbon, there is more cementite present than can become associated with ferrite, and the excess being unable to find a partner, so to speak, exists in separate particles, either granular or in a more or less perfect net work surrounding the pearlite.

The definite percentage of carbon which yields a full pearlitic structure in the annealed or natural condition is known as the eutectoid composition. Steels of lesser carbon are called hypo-eutectoid, and steels of higher carbon are called hyper-eutectoid steels. We are indebted to Professor Howe for these names.

When carbon steel is heated above a certain temperature, a change takes place in the constitution of the steel. This temperature is known as the carbon change point, critical temperature, or, preferably as the decalescence point. When this temperature is reached the pearlite becomes austenite, a solid solution of iron carbide in iron. This change occurs at a nearly constant temperature, but in case of hypo-eutectoid steels, the austenite first formed above the decalescence point acts as a solvent for the excess ferrite. In other words, at a somewhat higher temperature than the decalescence point, we obtain a homogeneous solid solution of all the cementite in all the ferrite. This is the best condition for hardening a low-carbon tool steel and accounts for the practice of heating low-carbon steels hotter than hyper-eutectoid steels for hardening.

The excess cementite of hyper-eutectoid steels is not readily soluble in the austenite first formed from the pearlite and it requires a high temperature to complete the solution of the excess cementite. Practically considered, nothing is gained by doing so.

Steels quenched quickly from above the decalescence temperature retain the carbon more or less perfectly in the condition of solid solution that existed above the decalscence point. The structural name for the quenched product is martensite. Hypoeutectoid steels, hardened, may show either all martensite or martensite and ferrite. Hyper-eutectoid steel should show martensite and cementite. The martensite of eutectoid steels has been called hardenite by Professor Arnold.

Just as in the change of ice to water or of water to ice, there is an evolution or absorption of heat, so is there an absorption or evolution of heat in steel on passing through its critical range. There are several methods of determining this change point, but as these methods are so well known, we will omit detailed descriptions of the operations involved.

The position of this critical temperature is fairly constant in all straight carbon tool steels, but is affected to a variable degree by the addition of alloys. Just as the addition of salt to water lowers the temperature at which the solution freezes, so the addition of alloys lowers the freezing point of steel and frequently lowers the position of the critical temperatures. The addition of 10 per cent of nickel to a 1.00 per cent carbon steel, or of 4 per cent of manganese, for example, lowers the critical point to such an amount that steels of these types are martensitic at ordinary temperature, even after slow cooling.

The determination of critical temperatures has materially assisted in the solution of many metallurgical problems. So far as we are concerned in this paper, however, it is sufficient that for the practical hardening of tool steels this critical temperature must be exceeded by a fairly good margin, at least 25 deg. to 50 deg. fahr., depending on the size, shape, mass and composition.

On heating steel through its critical range changes occur other than those noted. Steel is strongly magnetic below the critical range, but loses its magnetism within and above. The electrical resistance for hard steel increases with the temperature up to the critical point in a curve which is nearly a straight line. On passing through the resistance increases abruptly, and after having passed through, the increase per degree rise in temperature is very much less than in either of the other two cases. The specific volume of a hardened steel is approximately 0.01 greater than in its annealed condition. These marked changes in physical characteristics occurring at definite temperatures are indicative of the disturbances going on in the steel and occur at the temperature at which carbide carbon goes into solution ou heating, or dissolved carbon is precipitated from solutiou on cooling.

Of great practical importance to the hardener, however, are the volume changes, both expansion and contraction, which occur during the critical ranges of temperature. The permanent changes in dimensions which steel undergoes in hardening are of the utmost interest to the hardener and associated with these changes is the problem of hardening cracks.

Le Chatelier has studied the phenomena of expansion or dilatation by accurate scientific methods and has divided the changes into three zones of temperature: (a) changes at temperatures below that at which allotropic transformation begins; (b) changes at temperatures above those at which allotropic transformation occurs; and (c) changes occurring within the critical range itself. During the first of these periods from 0 deg. to 700 deg. cent., iron and steel expand nearly equally, the amonnt of carbon exerting little influence. For any iron or steel, however, the amount or rate of dilatation increases with the temperature. Below 100 deg. cent. the dilatation is about 0.000011 in., while

*A paper presented at the annual meeting, December, 1914, of The American Society of Mechanical Engineers.

between 600 deg. and 700 deg. cent. it increases to 0.0000165 in. per deg. cent. Above the critical range, however, the coefficient of dilatation varies directly with the carbon and is nearly twice as great for a 1.20 carbon steel as for a 0.05 carbon iron. The changes taking place at AC_1 and AR_1, Le Chatelier has not been able to study so satisfactorily. He has found, however, that the dilatation which increases directly with the temperature up to AC_1, suddenly stops and that instead of an expansion, a *marked contraction* takes place.

On cooling steel from high temperatures, these changes in dimensions are reversed, although they are not quantitatively equal, nor do they occur at the same temperatures. It is an axiom that heat expands and that cold contracts; but with steel there is a certain critical temperature at which an abnormal behavior is noticed, namely a sudden shrinkage on heating and an expansion on cooling. The expansion of steel in heating to 750 deg. cent., is about ⅛ in. per ft., and when we recall that, in quenching, a corresponding contraction attempts to take place suddenly, it is little wonder that strains are set up that may exceed the ultimate strength of the steel.

RELATION OF ABOVE TO OVER-HEATING

What is the relation of the above to over-heating, i.e., heating above that temperature at which it is necessary to harden? After passing through the critical range, the expansion takes place at its maximum rate. When steel is heated in such a manner it assumes the shape corresponding to the maximum temperature and on cooling the whole piece tends to return to, or near, its original size. In so doing, the outer, or first cooled, portion is hardened first and forms a hard, brittle, unyielding shell, and the strains set up by the slower cooling interior may either (*a*) fracture the shell producing external cracks, especially if the shell be uneven in thickness, or (*b*) burst the piece at the center if the shell is of even thickness and strength. This latter occurrence is accompanied by a peculiar appearance of the fracture and frequently and wrongly called pipe.

TIME OF HEATING

Too much stress cannot be laid on the fact that there is a correct length of time for heating and that this time of heating is as important as the temperature to which heated. There are at least two dangers which must be avoided.

First, if the heating be too fast, a uniform temperature does not exist throughout the mass being heated. For example, a die block heated too quickly may exhibit the following conditions: The outer portions may be above AC_1, and expanding at the maximum rate; the intermediate portions may be in the transformation range and contracting; while the inner portion, which is below AC_1, is slowly expanding at the characteristic rate below AC_1. What wonder that steel fractures under such conditions?

Second, grain size depends among other variables under (*a*) temperature above AC_1, and (*b*) time above AC_1. If heating be of such a character that the piece is held above AC_1, for an abnormally long time, the crystals may have grown to such an extent that on quenching, abnormal grain size is retained and the result is a weak, if not cracked, piece.

Quick heating in a furnace which is considerably hotter than the correct hardening temperature is extremely bad practice. The difficulty is that the thin parts, corners, and edges are liable to attain an overheated temperature before the larger portions of the piece attain the correct hardening temperature, and this overheating of the thin parts produces large grain size, abnormal expansion and tends to produce cracks.

SPEED OF QUENCHING

If a sample of steel be cooled slowly from above AC_1, the solid solution which has been formed breaks up and precipitates its cementite and ferrite and we have then an annealed steel. If the cooling on the contrary be rapid, the solid solution is not given the time necessary to permit the complete dissociation into cementite and pearlite and we find formed the intermediate break down of austenite, known as martensite. If the cooling be intermediate in its speed between extremely slow and extremely fast, we find intermediate microconstituents, troostite or sorbite. The correct constituent, however, in a hardened steel is martensite, and to form this martensite the material must be cooled quickly.

There are several degrees of "quickness' which at once suggest themselves. There is, however, a critical rate of cooling through the range which must be attained before the piece will be hardened.

On quenching it is clear that the surfaces of the section are cooled and hardened first. If the mass being cooled is of considerable size, different degrees of hardness are noticed from the outside to the middle. This can be illustrated by the following two examples, which, however, are not tool steels (Table 1).

Bars of the analysis shown, 3¼ in. sq. by 18 in. long, were quenched from indicated temperatures. A transverse section ½ in. thick was sawed from the middle and Brinell hardness tests made at equidistant points on its surface. It will be noted that in each instance the corners, or thinnest portions were the hardest. Next in hardness were the edges and the decrease in hardness was quite uniform to the center of the bar.

The cooling medium used, its temperature, and condition also affect the rate of cooling. Benedicks has investigated this subject and arrived at conclusions of extreme interest. He found that in order that a liquid present in large bulk may exhibit a good quenching power it is necessary:

a That it should possess a high latent heat of vaporization

b That it be maintained at a temperature low enough to avoid too abundant formation of vapor.

High specific heat, low viscosity and large heat conductivity all act, it is true, in the direction of quick cooling, but the influence of the two factors last mentioned appears to be of a different and lesser grade than the heat of vapor formation.

TABLE 1 PENETRATION OF HARDNESS

	1	2	3	4	5	6	7	
1	411	359	321	314	321	359	411	3¼ in. sq. by 18 in.; water, 1500 deg. fahr. ½ in. transverse section from middle of length. C, 29, Si, 09, Mn, 65, P, 01, S, 01, Ni, 3.47.
2	359	316	297	281	297	318	400	
3	337	283	283	280	283	295	340	
4	330	283	280	280	280	283	335	
5	337	278	283	280	285	298	340	
6	359	301	297	281	297	301	380	
7	411	359	337	317	337	380	420	
	1	2	3	4	5	6	7	
1	359	353	337	317	337	353	359	3¼ in. sq. by 18 in. oil, 1675 deg. fahr. ½ in. transverse section from middle of length. C, 0.49, Si,0.14, Mn, 0.74, P, 0.015, S, 0.014, Cr, 1.18, V. 0.17
2	350	335	325	320	323	327	350	
3	328	330	320	320	320	327	328	
4	325	320	316	314	316	320	325	
5	328	325	320	317	320	325	328	
6	350	327	323	319	323	327	359	
7	359	350	328	325	328	359	362	

The authors have devoted considerable time to investigating numerous commercial media which are in use in typical hardening plants of the country at the present time. The results given are only a small portion of those actually obtained, but they are typical.

In attacking the problem, the following method was adopted: A test piece of the dimensions shown in Fig. 1 was machined from a solid bar, and a hole drilled through the neck to within an equal distance from each side and bottom of the test piece. Into this hole a calibrated, platinum-rhodium couple was inserted and the leads connected to a calibrated galvanometer. The test piece was then immersed in a lead pot, also containing a thermo-couple to the point *A*, and the lead pot was maintained at a temperature of 1200 deg. fahr. When the couple inside the test piece was at 1200 deg. fahr., and the couple in the lead pot read 1200 deg. fahr., the test piece was removed and quenched to the point *B* in 25 gal. of the quenching medium under consideration. At the start the quenching medium was maintained at room temperature. The time in seconds that it took the test piece to fall from a temperature of 1200 deg. fahr., to a temperature of 700 deg. fahr., was noted by the aid of a stop-watch. It is clear that immersing the test piece in the quenching medium raised the temperature of the medium. The test piece was then replaced in the lead, heated to 1200 deg. fahr., quenched into the medium at this higher temperature and the time again taken with the stop-watch. These operations were continued until the quenching media, in the case of oils, had attained a temperature of about 250 deg.

fahr. The results obtained, time in seconds, for a fall from 1200 deg. fahr., to 700 deg. fahr., were plotted against the temperature of the quenching medium and a series of curves were obtained.

A consideration of the results is interesting. Pure water has a fairly constant quenching rate up to a temperature of 100 deg. fahr., where it begins to fall off. At 125 deg. fahr., the slope is very marked. Brine solutions have both a quicker rate of cooling and are more effective at higher temperatures than water. The curve does not begin to fall off seriously until a temperature in the neighborhood of 150 deg. fahr. is reached. Where water at 70 deg. fahr., cooled the test piece in 60 sec., the brine solutions cooled it in 55 sec.

As is well known the oils are slower in their quenching powers than water or brine solutions, but the majority of them have a much more constant rate of cooling at higher temperatures than water or brine.

The curves for thick viscous oils somewhat similar to cylinder oils are particularly interesting in that they have slower quenching abilities at low temperatures than at higher temperatures.

A comparison of curves show the variation in quenching power of the same oil due to continued service. The differences in quenching rates may well account for different results from the same steel in different shops, or in the same shop due to change of oil used.

HARDNESS AS AFFECTED BY MASS

It has been known for some time that different masses of the same material on being quenched under like conditions gave varying physical properties, but it is only within recent years that the quantitative effect has been measured. The authors give below a few results, which, although obtained several years ago, are printed for the first time.

Test pieces 4 in. long were made from the same ingot in sizes increasing ⅛ in. in both breadth and thickness. The smallest was ⅜ in. square and the largest 3¼ in. square. Three ingots of different type analyses were chosen and a series of test pieces made from each. The test pieces were heated in a semi-muffle furnace to a constant temperature of each type of material, quenched, and the Brinell hardness test made. Each series was then drawn to 600 deg. fahr. in a salt bath and Brinell tests again taken and then reheated to 1200 deg. fahr. in a salt bath and Brinell hardness tests again run.

The smaller the sample the greater the figure of hardness, indicating that the smaller sections are cooled with greater rapidity than the larger, and hence more hardness is developed. The same agencies are at work in tool steel. The larger the mass the smaller the depth of hardness when quenched under similar conditions.

Benedicks has shown that for steel of constant mass, the higher the temperature, the greater the rate of cooling. Two of his results will be sufficient to cite.

Weight of Specimen in Grams	Deg. Cent. Quenching Temperature	Cooling Time, Seconds
12.3	845	4.43
12.3	703	5.73

These results confirm our experience that in order to produce the same amount of hardness in a small and large section it is necessary to heat the larger section hotter than the smaller. A commercial application of this phenomenon will perhaps be interesting. The authors were recently confronted with the problem of finding out the correct temperature for hardening tools made from the same steel in sizes varying from $\frac{5}{16}$ in. diameter to ¾ in. diameter. The temperature-size curve shown was finally adopted (Fig. 19). In other words, a $\frac{5}{16}$ in. round will harden at 1395 deg. fahr., while a ¾ in. round bar should be heated to 1450 deg. fahr.—a difference of 55 deg. fahr.

TIME AND DEGREE OF DRAWING TEMPER

After the hardening operation has been safely performed, the next important step is that of drawing the temper. This operation is necessary for two important reasons:

a The relieving of abnormal strains set up due to the quick contraction or expansion.

b The breaking down of the extremely hard and brittle structure of the quenched steel.

The authors have seen expensive tools such as broaches, dies, etc., actually burst and fly apart due to the fact that the strains set up in hardening were not relieved by drawing the temper soon enough after the hardening operation. If this paper can impress upon its readers the absolute importance and necessity of drawing the temper *immediately* after hardening, the authors feel it will not have been in vain.

As previously shown in a properly quenched and hardened steel the hardening carbon, i.e., that up to 0.90 carbon, exists in the form of carbide of iron Fe_3C dissolved in iron, and the solution is known as martensite. If the steel is hyper-eutectoid, i.e., higher than 0.90 carbon, all that up to 0.90 is dissolved and the remainder exists as globules of undissolved cementite scattered throughout the matrix. The drawing of the temper begins to break down the true martensite structure and as the temperature increases there are formed intermediate micro-structures between martensite and pearlite, first troostite, then sorbite, and finally pearlite.

Professor Heyn has published some valuable results on the decrease of hardness on tempering. The results are expressed in per cent of the original hardness.

100 deg. Cent......	2.5 per cent.	400 deg. Cent......	70.0 per cent.
200 deg. Cent......	14.0 per cent.	500 deg. Cent......	87.5 per cent.
300 deg. Cent......	41.0 per cent.	600 deg. Cent......	97.5 per eent.

Regarding the effect of time on drawing the temper we submit the following. Standard ½ in. round A.S.T.M. test pieces were quenched from constant temperature into the same medium, and the temper drawn in same salt bath at constant temperature for five minutes, fifteen minutes, etc.

Elastic Limit	Maximum Strength	Elongation	Reduction	Brinell	Remarks
228,750	260,137	2.5	....	425	1550-oil-800 deg. fahr. 8 min.
201,125	214,562	11.6	45.4	390	1550-oil-800 deg. fahr. 20 min.
175,000	183,187	12	49.35	340	1550-oil-800 deg. fahr. 40 min.

Each of these results is the average of four closely agreeing checks. A study of the above table shows that time at the drawing temperature has a marked effect. The act of breaking down the martensite is progressive and not sharply defined. Both time and temperature have their effects. The greater the initial hardness of the piece, the more marked is the effect of drawing the temper.

Thallner states that two kinds of strains are present in hardened steel: (*a*) those which occur in steel of small cross section which hardens throughout; (*b*) those which occur in steel of larger cross section due to unequal change in volume of the surface and interior. The first of these also occurs in steel of larger cross section, but to the greatest degree on the surface. Thallner also classifies steels as (*a*) those which become shorter and (*b*) those which become longer or shorter in hardening. The two classes are not sharply divided. In pure carbon steels, the line of demarcation is about 0.90 carbon. In steels which lengthen, an increase in both length and width may also occasionally be observed and the larger cooling surfaces usually become convex. Thallner cites five crucible steels which he examined as shortening and eight basic open hearth steels, as lengthening.

The tendency of steel is to become spherical by repeated quenchings. Law, working with a square piece of tool steel 3½ in. by ½in. by ½ in., quenched it 550 times and at the end of this work, the piece was nearly round in cross-section. The ratio of length to diameter had changed from 3½:½ to less than 2:1. An equally interesting observation by Mr. Law was that the steel did not lose carbon or change in any way in composition.

Professor Howe has this to say in explanation of the change in shape which results in hardening a round bar. "The exterior first cools, contracts, becomes rigid, its dimensions being determined by the side of the still comparatively hot, expanded, mobile interior. The resistance of the interior to the return of the exterior to the dimensions it had before heating acts on that exterior precisely as a tensile stress on a body at constant temperature. If very powerful, it strains it beyond its elastic limit, it takes a permanent set, is permanently distended. The stress may

exceed the ultimate strength of the outer layers, which then crack, the piece breaks in hardening. The interior continues to contract; its adhesion to the now rigid, distended exterior prevents its own complete return to its initial dimensions. It may in its struggle to reach them somewhat compress the exterior, but not enough to efface the distention previously caused. The piece as a whole remains somewhat enlarged, and its specific gravity is lowered. After the cooling has progressed slightly and the outside has contracted more than the still comparatively slow cooling and disproportionately distended interior, it is no longer able to contain it and at the same time to preserve its original shape. It is, therefore, shortened and bulged, thus slightly approaching the spherical shape in which the minimum of exterior holds the maximum of interior; and this distortion is not wholly effaced by the contraction of the interior.''

Many years ago, one of the authors made several hundred hardening experiments and several thousand measurements to study the change of shape. The materials used were cylinders of steel and taps. Crucible steel alone was examined and the following variables were considered: (*a*) the effect of original form or diameter upon the diameter after hardening; (*b*) the influence of carbon on change of form; (*c*) the influence of initial temperatures at quenching; (*d*) the influence of length of time of heating; (*c*) the influence of repeated hardenings, and (*f*) the effect of annealing previously hardened steels, upon change of shape in rehardening. Obviously when plain cylinders of steel are considered, there are four possible changes of shape possible, expansion in length and diameter, contraction in length and diameter, expansion in length and contraction in diameter, and contraction in length with expansion in diameter.

Under the influence of the variable conditions mentioned above, all four changes were actually produced. Steel was also found which expanded in length on first hardening and contracted indefinitely thereafter on repeated hardenings. Another steel expanded in length on two hardenings and contracted on the next two. In a variable carbon series of steels from 0.50 to 1.33 per cent carbon, the magnitude of the change in length after four hardenings, increased as the carbon increased. For the same series it was noted that the volume changes were greater when hardening annealed rather than unannealed bars. The increase in length is greater the higher the hardening heat for all carbons. The details of this work would take us too far from the purpose of our paper. The point we wish to emphasize strongly is that it is variable conditions that give variable results. Hence, it is of vital importance that steel be furnished uniform, chemically as well as physically, and it is equally important that the user employ every possible refinement in the handling of his product. It is only under varying conditions of heat, size, time, composition, etc., that the results vary. Constant conditions give constant results. Different steels will not behave alike in all cases, but it is a simple matter to determine under any given set of conditions how a particular steel will behave. Other things being equal, therefore, the original composition, grain size, condition of annealing and the method of manufacture affect the resulting changes in form after hardening. Above the decalescence point, the coefficient of dilatation increases proportionately with the carbon and for all carbon percentages the rate of dilatation increases with the temperature. Resulting changes of form are conditioned by the original proportions of the piece quenched, by its chemical composition, by the temperature from which it is quenched, and within certain limits by the time of heating. Hardness, brittleness, change of form and liability to crack, generally speaking, increase with the carbon content and the temperature and time of heating. Nevertheless, constant conditions give constant results.

It cannot be overlooked, however, that constant conditions are not always attainable. The maker of steel cannot control conditions in his customer's shop and the customer cannot control conditions in the steel plant and the human element must be considered in both. The properties we have been describing are inherent properties of carbon steel, and because of them many a dispute has arisen over tools lost in hardening. The placing of the exact responsibility is very difficult even though it were not true that it is human nature to shirk responsibility.

The way to avoid such disputes would naturally be simplified if a steel possessing all the desirable qualities of carbon tool steel could be produced, omitting most of its faults and eccentricities. A product introduced in this country nearly ten years ago by the company with which the authors are associated, is perhaps the nearest approach to this ideal. Since we were, personally, in no way responsible for its development, we feel it is not out of place to mention it here for we consider it an achievement, next only in importance to the discovery of high-speed steel in the evolution of tool steel metallurgy. This product has been so largely used for nearly ten years in America that it is not necessary to describe its peculiar characteristic of undergoing almost no change in shape, no warping, expansion or contraction in hardening. It is not so foolproof that it cannot be injured by abusive treatment, yet with reasonable care it permits the tool maker to produce parts which, after hardening, are of exact size and fit, to make threaded and threading tools to exact standards, and to produce most intricate punches and dies which can be hardened with safety and a minimum of risk.

FURNACES AND METHODS OF HEATING

Much has been said regarding the superiority of gas furnaces over oil furnaces and vice versa. The fuel used is immaterial for good practice so long as the following points are taken care of:

a The furnace and hearth should be of sufficient size so as not to be affected materially in temperature by the introduction of the parts to be hardened.

b The furnace should heat at a uniform rate.

c The furnace should be of uniform temperature over its entire hearth.

d The furnace should be run under neutral, or reducing conditions. A good rough test for this is the introduction of a piece of wood or paper upon the hearth. If the paper, or wood, burn, the atmosphere is oxidizing. If they char, reducing or neutral.

e The temperature control must be at all times exact and it must be possible of exact duplication on repetition work.

A blacksmith's fire is satisfactory under good handling but the difficulty is the fact that for constant work it is too exacting on the operator and requires too many manipulations to secure uniform and continuous results.

IN CONCLUSION

We have endeavored to enumerate the factors which enter into the every-day operation of hardening tool steel. It is the duty of the user of steel to study these influences and through study and experience to properly weigh the many problems presented in what is frequently considered a simple operation. The various factors are not always of equal importance and must be considered in connection with the size and nature of the object being hardened and the duties expected of it after hardening. To expect uniformly good and consistent results from a hardener whom you have not provided with adequate or suitable equipment is unreasonable. When the question of good equipment in the way of furnace, quenching arrangements and media, pyrometers, etc., has been satisfactorily taken care of, your hardener still has plenty of variables to contend with which are beyond his control. We hope we have made clear what some of the variables are and have excited some interest and desire upon the part of those responsible for hardening results to study them as they have not studied them before. The hardener's task is a difficult one and if we have presented herein any suggestions of value our efforts will not have been in vain.

GENERAL FOREMEN'S CONVENTION.

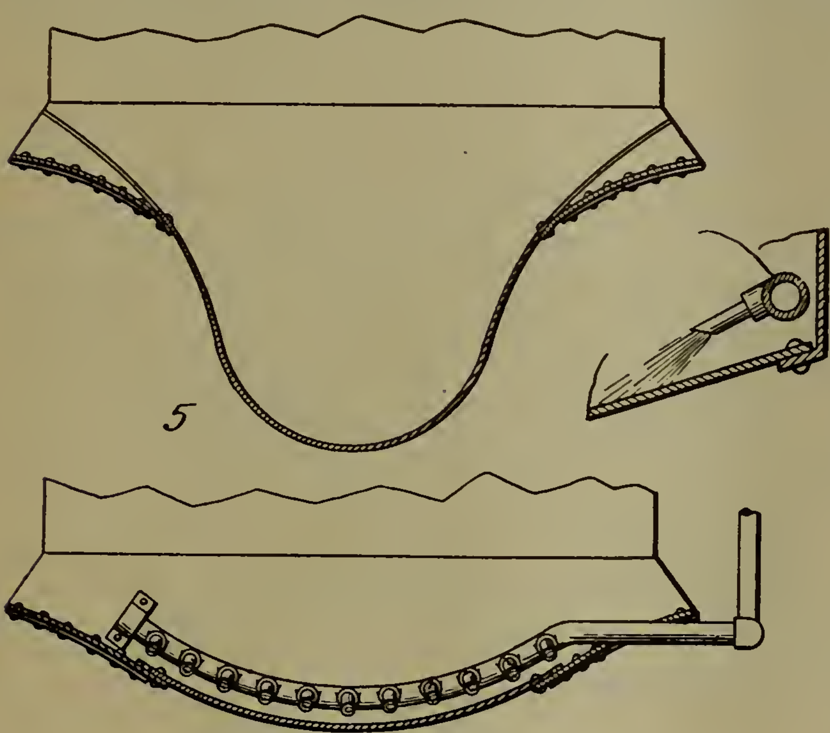
The International Railway General Foremen's Association will hold its next convention at the Hotel Sherman, Chicago, Ill., on July 13 to 16, inclusive. The last convention was the best, from every standpoint, ever held by this association, and the several committees are doing their utmost to make the 1915 convention still better.

MADDEN HOPPERLESS ASH PAN.

The ash pan shown in the illustration has recently been patented by T. P. Madden, traveling boiler inspector of the Missouri Pacific, at St. Louis, Mo. The pan is designed to prevent the dropping of live coals on the right-of-way and is of such a shape as to overcome the tendency to buckle on account of unequal heating. The pan is in the form of a chute which gradually becomes deeper and narrower from one end to the other. The forward and highest end of the body is formed on a gradual curve and the pan then becomes deeper and narrower, so that the extreme rear end has a comparatively small radius. The body of the pan, therefore, is in the form of a tapered chute, which causes the ashes to fall by gravity to the lower end of the pan. This lower end is normally closed by a fixed plate and a hinged door, which can be opened by means of a lever from the locomotive cab.

At the wide upper end of the pan is a header fitted with a series of nipples so that jets of water issuing from them will be deflected downward on the pan. This can be used to kill any live coals and to flush out the ashes. The main body of the pan may be either formed of sheet metal or cast and may be made in a single piece or in sections. It can be made suitable for any type of locomotive; pans for Atlantic, Pacific and Mikado class engines sloping towards the front end of the fire-box. Air inlets are provided at the mud rings.

The material used is ¼" tank steel and consists of three plates to complete the pan. The original cost is said to be approximately $25 less per pan than that of the old style hopper pan and no roundhouse repairs are necessary between general overhaulings. Repairs to spring rigging, equalizers, shoes and wedges can be made without removing any part of the ash pan.



Sections of Madden Ash Pan.

The Missouri Pacific has 150 of these pans in service and is applying 12 pans per month, the design having been adopted as standard. The Atchison, Topeka & Santa Fe is applying four of the pans for demonstration and the Denver & Rio Grande and the Missouri, Kansas & Texas have also applied a number of the pans.

HABIT.

Source of about three-quarters of all human actions, time saver and thought saver, best of slaves and worst of masters—that is Habit.

The strength of it is beyond the realization of the people who are most dependent upon it. And its danger is as great as its value, according to the character of the habits themselves.

A reflective friend of ours has occasion to pass through a certain street every evening at seven o'clock. And he says that every night he meets the same people, four or five of them, doing the regular things, so that he looks forward to seeing them, and he is never disappointed.

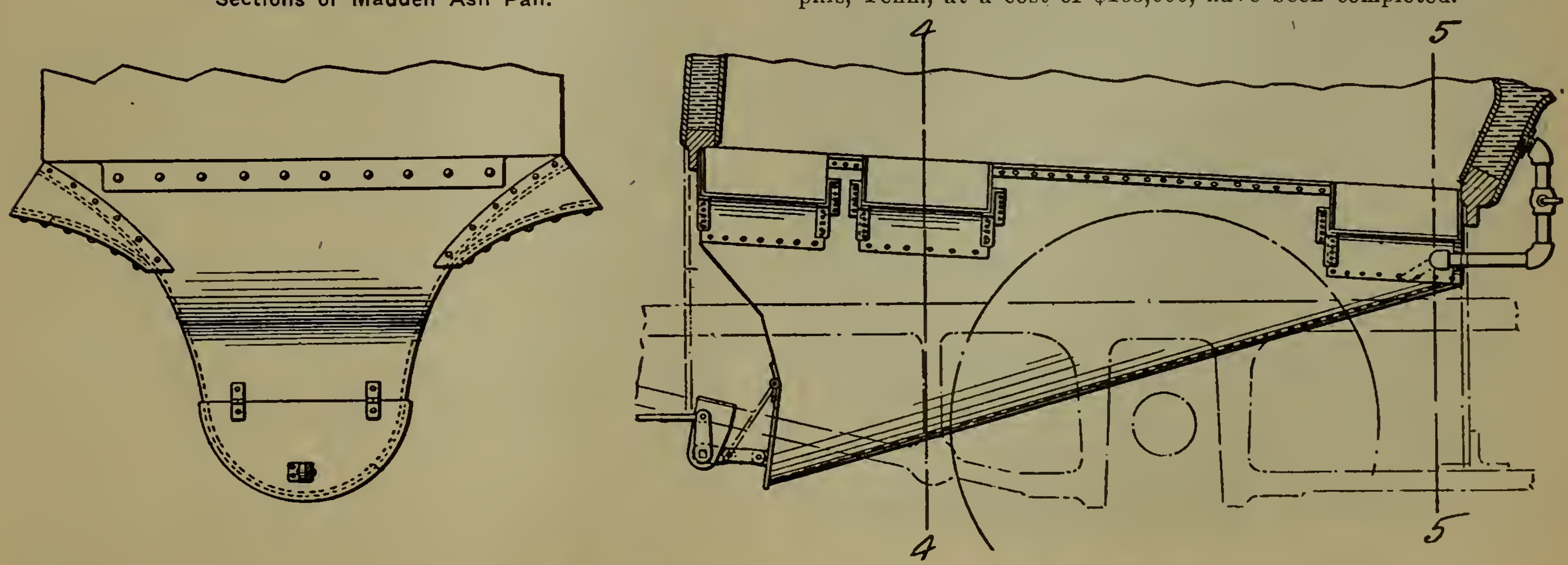
There is a man who always runs for the seven o'clock car, when he might as easily catch it if he changed his habit of leaving at the last minute to one of leaving the minute before. And then there is the man who drops in regularly at the corner saloon not because he particularly needs a drink, but because he has done it regularly for some time, and it's easier to do it than stop it. And then there is a family at dinner he sees as he passes, and the boss is always in his shirtsleeves although it is no longer hot weather. You see, he is simply dining with his wife, and he has the habit of doing it this way, and she never gets used to it. But she knows better than to try to change his lordship.

Those are some of the habits our reflective friend runs into as he walks through the street nightly. And it leads him to make up his mind that if habits are so infernally powerful, how much easier life is to a man who forms them along the right lines.

"For," says our friend, "you might as well get the habit of doing it right as of doing it wrong—it's exactly as easy once you get it going. And it pays—it's good business. And the habits of punctuality, and neatness, and courtesy, and patience, and a hundred or so more, are so important to life that men call them virtues. But they are habits, just the same."—*Drill Chips.*

THE CENTRAL RAILWAY CLUB held its annual meeting at the Hotel Statler, Buffalo, N. Y., on January 8. A paper was presented by E. J. Dickson, vice-president of the International Railway Co.

Tentative plans for the construction of the Illinois Central railroad's icing plant, to be built in Nonconnah yards, Memphis, Tenn., at a cost of $165,000, have been completed.



End and Side Views of Madden Hopperless Ash Pan.

VENEERED STEEL FOR PASSENGER COACHES.

A suitable interior finish for passenger cars has been one of the problems which the railroads and car builders have been endeavoring to solve for some time and more especially since the advent of steel car construction. A suitable finish should in a general way possess the following qualities: Lightness, strength, durability, pleasing to the eye, poor conductor of heat, occupy a minimum of space and be fire resisting.

An all wood interior finish is bulky and does not seem to be in harmony with modern car construction. While it is possible by using great care to make a clever imitation of wood by using steel interior finish, the mere fact that wood is imitated would seem to indicate that wood is the desirable finish, but with the use of steel there are many disadvantages that do not seem to be much nearer solution than when steel was first used.

The steel surface is often wavy even when new, particularly on flat surfaces; it is easily dented and the dents or buckles cannot be easily removed. It is very cold and noisy, and corrodes on the unexposed side.

It seems that the question of a suitable interior finish has been solved by the Canadian Pacific Railway. This is accomplished by the use of veneered steel. The veneer is of varying dimensions, from 1/18th of an inch up, depending on the severity of service which is governed by the location in car and class of car.

This veneered steel is used in the construction of doors, panels, wainscot, bulkheads, sleeping car berths, sleeping car seat ends, etc., and is of approximately the same cost as steel or wood. It has the insulating effect of wood, is not subject to corrosion the same as steel alone, does not splinter in wrecks, is fire resisting and can be made attractive to the extent that one cares to go into the use of beautiful veneers. In other words, it combines all the good points of wood and steel with none of the disadvantages of either. It is not an experiment as it has been used sufficiently long to know that it does not deteriorate and is now in service on about sixty cars. Its use has also been arranged for on diners, sleepers, coaches and all passenger carrying cars.

In the construction of doors, bulkheads, panels, etc., the veneer is used on each side of the steel and in this way oak can be used on one side and mahogany on the other, or any other class of wood that is desired.

In the illustration, all of the wood in sight in the bulkheads, smoking room partition, etc., is of thin veneer, except the casings for the door frame and the moulding.

This veneered steel finish is the invention of R. W. Burnett, general master car builder of the Canadian Pacific at Montreal.

Mahogany Veneered Steel Bulkhead.

Mahogany Veneered Steel Doors.

THE AMERICAN RAILWAY TOOL FOREMEN'S Association has distributed a goodly supply of its proceedings among superintendents of motive power and master mechanics, each copy being accompanied by a circular letter urging co-operating with the association. As the letter states, "Good tools are essential and are the broad base from which mechanical efficiency originates."

A PUMPKIN EXPLOSION.

The following from the *Detroit Free Press* will be interesting to those connected with boiler work. Since there is so much agitation at present in regard to inspection of boilers, it might be advisable to suggest a pumpkin inspector to prevent any possibility of a recurrence of the accident as noted below:

Poughkeepsie, N. Y., March 20.—Mrs. James Crasher of Freedom Plains, Dutchess County, is minus a kitchen range and wonders why she escaped without serious injury in a peculiar accident today.

A pumpkin, which she was thawing out in the oven, blew up and wrecked the stove, besides shattering every window pane in the kitchen. Steam which formed inside the pumpkin caused the explosion. Mr. Crasher had left the pumpkin in a woodshed, where it froze.—*Loco.*

The Lake Shore & Michigan Southern was consolidated with the New York Central at a meeting of Lake Shore stockholders held at Cleveland, O., on Dec. 22, when they ratified action taken by New York Central stockholders July 20 last. The merger involves $300,000,000. Officials of the road claim that as a result of the merger the New York Central is now the largest railroad system in the world.

While no official statement was made pending action of the board of directors, it is believed that A. H. Smith, now president of both the Lake Shore and the New York Central companies, will be elected president of the newly formed system. It is said that the merger will result in the removal of the general offices of the Lake Shore from Cleveland to either New York or Chicago.

A fee of $319,590, establishing a new record, was paid the state of Illinois in connection with the consolidation of the Lake Shore & Michigan Southern and the Chicago & Indiana Southern railroads with the New York Central and Hudson River railroad.

ELECTRIC TRACTION ON STEAM ROADS.*

This committee was appointed to review the present status of electric traction as applied to steam railroads and to present the principal features of and reasons for electrifications. It is the intention to present matters of general interest to railroad men without going into the technical details, which are the province of the consulting electrical engineer. The ordinary urban and interurban railway lines will not be discussed as it is intended to apply only to the electrification of steam railroads or electric railways built to handle steam railroad class of traffic.

PRESENT ELECTRIFICATIONS.

The first electrical operation of railway equipment occurred on the Metropolitan Elevated of Chicago, in 1895, and three years later the multiple unit system of trains was first operated on the South Side Elevated of Chicago. These roads were operated with 550-volt direct current by the use of a third rail, which had been used initially on the Intramural Railway at the World's Fair. A few years later the Boston Elevated Railway was built, using a similar system, and in 1902 the Manhattan Elevated Railway of New York changed from steam to electrical operation, using a similar third rail system and multiple unit trains.

Numerous small electric locomotives had been built for mining and industrial purposes, but the first electric locomotives for trunk line railway use were put in service in the Baltimore tunnel of the Baltimore & Ohio, in 1895, and weighed 96 tons. Later several 160-ton two-unit locomotives were added to the electric equipment.

The western portion and a number of branches of the Long Island Railroad comprising 125 miles of single track were changed to 600-volt direct current electric operation in 1905. The electrification has been extended in recent years. Passenger traffic only is operated by multiple unit trains.

The following year the West Jersey & Seashore between Philadelphia and Atlantic City was electrified and operated multiple unit trains, using 600 volts direct current supplied by a third rail. This installation, covering 75 miles of double track, was noteworthy as being the first for long distance express service.

The Grand Central Terminal of the New York Central & Hudson River was changed to electric traction in 1906, and the electrification has gradually been extended from New York to White Plains on the Harlem division, 22 miles, and to Harmon on the Hudson River division, 33 miles, the system now comprising a total electrical single track mileage of approximately 165. There are sixty-three 115-ton locomotives now in service. The through trains are operated by electric locomotives interchanged with steam locomotives at the end of the electrified zone. The suburban traffic is handled with multiple unit trains. The third rail system of distribution is used, supplying direct current at 650 volts.

The New York, New Haven & Hartford was electrified in 1907 and originally extended from Woodlawn (between which point and New York it operates over the tracks of the New York Central) to Stamford, Conn., 21 miles. This electrification has since been extended to include the Harlem River branch into New York and also from Stamford east to New Haven, aggregating about 160 miles of track. Through passenger and freight trains are hauled by electric locomotives. There are now about 100 locomotives of various classes, weighing from 80 to 140 tons each. There have been a number of locomotive designs to meet the conditions imposed by the traffic, such as gearless, geared, two motors per axle and side rod types. Part of the locomotives also contain equipment for operation by direct current third rail, in order to run over the New York Central. Some of the local passenger trains are operated by the multiple unit system. This electrification was the first large installation of alternating current traction, 11,000 volts at 25 cycles single phase being used. The distribution system consists of overhead catenary with both the double and single type of suspension. This installation was a pioneer of its type for heavy traction and many of the details had to go through certain experimentation and modification which has been the early experience with the practical application of all systems.

In 1906 the Spokane & Inland Empire was built for handling both freight and passenger business by electric traction. It was one of the most extensive systems then operated wholly by electricity. Locomotives and multiple unit trains are used with a 6,600-volt alternating current single phase system of distribution.

During 1907 electric traction was installed on the Rochester division of the Erie for local traffic, using multiple unit trains. An alternating current system, similar to the New Haven electrification, was adopted with a single catenary supported on bracket construction. The power of this electrification was supplied by a sub-station at Avon from the Niagara Falls power circuits.

In 1908 the Grand Trunk electrified the St. Clair tunnel, using a 3,300 volts single phase alternating current with electric locomotives to handle main line trains through the tunnel.

The Cascade Tunnel of the Great Northern was electrified in 1909 and all main line freight and passenger service was operated thereafter through the tunnel by 115-ton electric locomotives. This installation is interesting as being the first in America using three-phase alternating current with induction motors on the locomotives, and up to the present time it is the only system of this kind in this country.

The Oakland, Alameda & Berkeley division of the Southern Pacific; the Oneida division of the West Shore in central New York; the Portland, Eugene & Eastern, Oregon, and the Pacific Electric System centering at Los Angeles operate passenger and freight service over steam railroad lines, using the 600-1,200-volt direct current system with overhead catenary.

The Piedmont Traction Company operates 140 miles of line at Charlotte and Spartanburg, N. C., using the 1,500-volt direct current system. It handles local passenger and heavy freight service with multiple unit trains and 55-ton locomotives, hauling 800-ton trains. This line was completed in 1913.

The Washington, Baltimore & Annapolis was originally electrified in 1907, using a 6,600-volt single phase system. In 1910 the system was changed to 1,200-volt direct current. Passenger and freight traffic is handled over about 60 miles of line.

The Rock Island Southern operates passenger and freight service between Monmouth and Rock Island, Ill., over about 60 miles of road. Locomotives and multiple unit cars are operated by single phase system using a 11,000-volt catenary.

The Fort Dodge, Des Moines and Southern operates about 126 miles of electrified lines between Fort Dodge and Des Moines, Ia. All traffic is handled by the high voltage direct current system.

The Denver & Interurban is an electrified branch of the Colorado & Southern and operates 44 miles at 11,000 volts single phase with multiple unit trains.

The Pennsylvania Terminal in New York, and the tunnel approaches were placed in operation in 1910, using the 700-volt direct current third rail system. This installation handles heavy passenger traffic only and the 156-ton locomotives are of the articulated type, using side rod drive. The Long Island also operates multiple unit trains into this terminal.

The Hoosac tunnel of the Boston & Maine is double track, five miles long, and the smoke conditions became so bad that the traffic could not be handled. Electric traction was adopted in 1911 and now all trains are hauled through by 130-ton electric locomotives, using the same single phase system as the New Haven.

The New York, Westchester & Boston was built for high speed electric passenger service and placed in operation during 1912. This road is 21 miles long, is part of the New Haven lines, and is operated by the same system, multiple unit trains being run.

Although direct current installations have been made at 1,200 to 1,500 volts, a higher voltage was not installed until 1913, when the Butte, Anaconda & Pacific was placed in operation, using 2,400 volts direct current. This road extends from Butte

*A committee report presented to the Association of Railway Electrical Engineers.

Hill to Anaconda, Mont., with branches, aggregating 37 miles, and is used principally for transportation of ore. Two 80-ton locomotives haul a 4,000-ton train on average level at 21 M. P. H. Passenger traffic is also handled by electric locomotives of the same weight but higher speed.

At the present time there is in process of electrification a 30-mile division of the Norfolk & Western at Bluefield, W. Va. The principal traffic on this division is the transportation of coal and the necessity of increasing the transportation capacity of the single track Elkhorn tunnel and obtaining more economical operation over heavy grades were the reasons for adopting electric traction. The electric locomotives have articulated trunks and weigh 130 tons. Four three-phase induction motors are installed on each locomotive, two on each truck geared to a jack shaft, which is connected to two driving axles by side rods. Two of these locomotives will haul 3,250-ton trains on light grades at 28 M. P. H. For 1% and heavier grades a speed of 14 M. P. H. can be obtained. A phase-splitting apparatus on the locomotive provides three-phase current for the motors. The distribution will be 11,000 volts single phase catenary supplied by outdoor transformer substations.

The Pennsylvania will electrify the Paoli division out of Philadelphia this year to increase the capacity of the terminal and tracks. This division is 20 miles long and the electrification will apply only to the suburban passenger traffic at present. Multiple unit trains will be used and an 11,000-volt single phase alternating current system of distribution adopted, using the single overhead catenary.

A most interesting application of electric traction has recently been decided upon for a mountain division of the Chicago, Milwaukee & Puget Sound. The total electrification contemplated is about 440 miles, extending from Harlowton, Mont., to Avery, Ida.; although only one division will be electrified at present, from Three Forks to Deer Lodge, 113 miles. The direct current system will be used at a potential of about 3,000 volts with catenary distribution. Two classes of locomotives will be provided to haul 800-ton passenger trains at 50 M. P. H. on level, and 2,500-ton freight trains over maximum mountain grades of 2%, respectively. This is practically the first instance of electrification being applied to a full division handling the regular trunk-line traffic.

The Canadian Northern will electrify the new Montreal terminal and tunnel through Mount Royal, together with a short suburban trackage, aggregating about ten miles of line. The 2,400-volt direct current system with catenary trolley will be used. The high voltage is adopted to provide a suitable distribution for future long-distance extensions of the suburban district. It is intended to use 83-ton locomotives with articulated trucks equipped with two motors per truck geared direct to driving axles. Multiple unit cars will be operated for suburban traffic. It is expected that this electrification will be completed during 1915.

There are a number of railroads, such as the Canadian Pacific, Denver & Rio Grande, the Erie and others, which are considering electrification of certain sections, but their plans are not far enough advanced for reference at this time.

EUROPEAN ELECTRIFICATIONS.

Much experimental work has been done on the various lines electrified in Europe, sometimes resulting in peculiar designs and elaborate details.

In general the traffic is less and equipment is lighter than in the United States. The better grade and lower cost of operating and maintenance labor used in Europe is favorable to the results obtained. The locomotives and distribution systems contain many refinements and are less rugged than usually considered necessary in this country.

Italy has adopted the three-phase, 15 cycle, 3,000-volt system and good results are being obtained throughout. Valtellina, Giovi, Savona-Ceva and the Monza-Lecco are the principal lines electrified. The Valtellina line was electrified in 1902, comprises 65 miles of track, operates at 3,000 volts, 15 cycles, three-phase, and has 24 locomotives. The Giovi line comprises 28 miles of track, was electrified in 1910-13, and has 24 locomotives. The Savona-Ceva line was electrified in 1914, comprises 28 miles of single track, and is operated at 3,700 volts, 16⅔ cycles, and has 24 locomotives. The Monza-Lecco line was electrified in 1914, using 3,400 volts, 15.8 cycles, and comprises 27 miles of track.

The single-phase, 15 cycle, 10,000-volt system is considered the standard system for trunk lines in France.

The principal electrifications are the Medi Railways and the Paris-Orleans Railway. The latter was electrified in 1898, eight 600-volt direct current locomotives being placed in service for the Paris end of this trunk line.

The standard recommended by the Commission of Swiss Engineers was the single-phase, 15,000-volt, 15 cycle system.

There is a total of 319 K. M. of railways operated electrically and of this, 210 K. M. are operated by the single phase system.

Although the Simplon tunnel and its approaches, comprising about 14 miles of track, has been in successful operation for the past 8 years and is showing good results with its three-phase system, it was not considered that this system was the best for general adoption for all Swiss roads.

The Loetschberg tunnel is one of the most recent electrifications using the single phase system.

The trunk lines in Germany are practically all owned and operated by the state governments. The Prussia system is the largest and represents the general conditions prevailing in other states.

The system recommended in a report to the Prussian Government some years ago and the one adopted is the single phase, 10,000-volt, 15 cycle system. This voltage is to be increased to about 15,000 volts if operation at a lower voltage proves entirely satisfactory. This increase in voltage has already been made on the Dessau-Bitterfeld road.

The locomotives on this system are equipped with large motors mounted on the cab floor, and connected to the drivers with inclined side rods, either direct or through a jack shaft. Experimental work is being carried on with the geared type as considerable difficulty has been experienced with mechanical parts of the side rod locomotive.

SYSTEMS.

Since the first trolley line installation in Richmond, Va., in 1888, which was low voltage, direct current, there has been a gradual evolution in traction systems based on the requirements for heavier and more extended service. On the one hand, this has led to increasing the voltage of the direct current system and, on the other hand, the system of alternating current traction has been developed in order to utilize the possibilities of high voltage distribution without limit.

At the present time electric traction systems may be divided in the general classifications of direct current and alternating current, each class having several methods of application varying more or less in fundamental details.

The Classification of Systems is as follows:

Direct Current.	Alternating Current.
1. Low voltage; 600-750.	3. Single phase with commutating motors.
2. High voltage; 1,200 - 2,400- 3,000.	4. Three phase with induction motors.
	5. Single phase with induction motors (split phase).

6. Direct current rectified from alternating current.

A brief review of the salient features of the systems will be given for reference.

Direct Current—Low Voltage.

This is the original and commonest form of electric traction in this country and applies particularly to trolley service both urban and interurban. It has been used extensively for short railroad electrifications, principally for terminal installations.

Details of construction and operation have been thoroughly worked out and very satisfactory results have been obtained.

The system is extremely flexible and is particularly desirable for its range of operating speed; but it cannot be considered economical for long lines carrying heavy traffic, as expensive substation installations are required in such cases and the distribution

system will be unduly expensive. The potential used for these installations varies from 500 to 750 volts, and for traction work a third-rail system of distribution is almost universal, as it is not practicable to collect the heavy currents taken by the locomotives from a trolley wire.

Direct Current—High Voltage.

It has been a natural step in the progress of electric traction to increase the voltage and thus reduce the amount of current to be transmitted for a given load requirement. First the potential was doubled and 1,200 volts has been used for a number of interurban electric railway installations. This voltage has not been used on any trunk line steam railway electrification, probably due to the fact that no such electrifications were decided upon during this period, because it shortly became evident that it would be practicable to use a still higher voltage. Therefore 2,400 and 3,000 volts is now considered standard for high voltage direct current heavy traction installation. It might be explained that this high voltage use of direct current for railway motors has been made possible by the development of the commutating pole (interpole) type of motors and the better insulation design which has been developed in the last few years. The railway motors are usually arranged to operate two in series thus giving 1,200-1,500 volts.

The method of control for the motor equipment is usually the series parallel rheostatic type similar to that which has become standard for low voltage traction and embodies the various details of electricity operated or pneumatically operated contractors arranged for multiple unit operation of two or more groups of equipment.

There has been some experimental work carried on in Europe with this high voltage direct current for traction purposes even in excess of 3,000 volts, but it is safe to say that this country is probably the leader in the practical application of this system at the present time.

It is doubtful if a third-rail system of distribution will be desirable for this high voltage direct current, due to the necessity for considerable insulation coupled with the requirement of obtaining sufficient clearness for the installation. It will be interesting to observe the experience of the Michigan United Traction Co., which proposes to install a 2,400-volt third-rail system. The Butte, Anaconda & Pacific is the only railroad actually in service using 2,400-volt direct current traction, although there are a number of other installations now in process of construction or contemplated.

The distribution of high voltage direct current is usually obtained from substations containing rotary converters or motor generator sets, which are supplied through transformers from a high tension alternating current transmission line. The converters or generators are of the interpole type, built to deliver 1,200-1,500 volts direct from one machine, and two of these machines are connected in series to obtain the high voltage.

The direct current systems have the advantage of a wide range of running speeds, and the tractive effort characteristic of direct current motors is also very desirable, as it gives very high values at low speeds and starting, and relatively low tractive effort at the higher running speeds.

A. C. Single Phase with Commutating Motors.

This is known as the single phase system, and has been used on a number of installations in America, and is quite generally used in Europe. The principal installation in this country is that of the New York, New Haven & Hartford, which is operated at 11,000 volts, 25 cycles.

The attractive feature of this system has been its ability to supply distribution direct to the locomotive at high voltage, the only limitation being the practicable insulation of the locomotive equipment. It has not been found necessary to go beyond 12,000 volts up to the present time, and this potential provides for heavy power supply with 20 to 30 miles between generating stations or transformer sub-stations if the power is taken from a transmission system.

It has been the standard practice in America to use 25 cycles for this system as a higher frequency is not practicable. Most of the European installations have been at 15 cycles, which is preferable from an engineering standpoint, but has not been looked upon with favor in this country as it requires the development of new apparatus and isolates the power system from the usual commercial power developments.

The advantages of this system consist in the elimination of sub-stations with rotating apparatus—an extensive electrification only requiring outdoor sub-stations containing transformers and switching equipment—and the smaller amount of copper for feeder requirements.

The single phase commutating type of motor cannot be considered entirely satisfactory, and the weight and first cost of this motor compared with direct current or induction motors is a disadvantage which apparently cannot be overcome.

As an auto transformer is used to supply the reduced voltage to the motors, the starting and speed control of the motor equipment is extremely simple, being obtained by any desired number of taps on the auto transformer. This provides a flexible operating condition and results in extremely smooth accelleration.

A. C. Three Phase with Induction Motors.

The three phase system of distribution, operating induction motor equipment on locomotives has been used considerably in Europe and is standard for the principal railways in Italy. A double trolley and track circuit is used for the three legs of the system. This system also allow a high voltage distribution similar to the single phase, except the proximity of the two trolleys necessarily place a more definite limit on voltage.

The only intallation of this kind in this country is through the Cascade tunnel of the Great Northern, and has been in successful operation for about five years.

The double trolley construction has always been considered difficult and impracticable in America, and is not looked upon favorably for extensive railway work, due to its high cost and difficult maintenance.

The induction motors have to run at a constant speed irrespective of the load, but in order to obtain a certain amount of flexibility it has usually been the case that two speeds are provided either by operating motors in Cascade, or by changing pole connections. This speed limitation might be a serious disadvantage for suburban traffic, where trains make frequent stops or run under close headway, but for trunk line operation it would not appear to be detrimental; in fact, it can be readily seen that there might be an advantage in operating trains over a division at a constant speed irrespective of train weight or grade.

The control of the induction motors is usually by means of resistance in the secondary circuit, and this gives very satisfactory results as regards smooth accelleration. Of course the absence of a commutator in the induction motor is an important advantage, and in general an induction motor is one of the most rugged types constructed and requires a minimum of maintenance.

It is doubtful if this three phase system of distribution will be used in the future, as the induction motor equipment can be supplied from a single phase system as pointed out in the following paragraph:

A. C. Single Phase with Induction Motors (Split Phase).

In order to get the benefit of induction motor equipment on locomotives and obviate the necessity of using a double trolley distribution, there has recently been developed a rotating piece of apparatus designated a phase-converter, which is a special form of induction motor located on the locomotive, and so arranged as to receive single phase alternating current from the line and provide three phase current for the motors. This combination has been designated the "split phase" system, and includes all the operating features of the three phase induction motor equipment, referred to previously, supplied from a single phase trolley.

An important installation of this system is now being made on the Norfolk & Western.

Direct Current Rectified from Alternating Current.

Experimental work has been carried on for some time with a system using the high voltage single phase distribution supplying alternating current to the locomotive or car containing transformer

and a form of mercury arc recifier, which in turn furnishes direct current at any voltage desired for the standard type of series motors.

Progress along this line is still in the experimental stage, so that none of the large manufacturers are yet ready to propose the use of this system for steam railroad electrification. However, it has very attractive features, and assuming that the details can be satisfactorily worked out, it would seem to be ideal for many installations.

Singe Phase Distribution.

It is apparent that the alternating current single phase distribution has certain advantages of high voltage and minimum sub-station and copper requirements which are distinctive. Furthermore, this form of distribution remains the same to supply single phase commutating motor, equipment, induction motor equipment, or (assuming its ultimate development) the standard direct current series motor through the medium of the mercury arc rectifier.

One of the serious operating difficulties which has been experienced with the single phase system of distribution is the interference caused by induction in other nearby parallel lines, such as telephone and telegraph wires. At times this had assumed a very serious aspect and considerable experimentation has been carried on to protect against such interference. This induction is caused by the fact that the trolley, constituting one leg of the single phase circuit, and the track the other are so far apart that the inductive fields set up extend to a considerable distance, thus affecting any lines within their scope.

It is claimed that there has now been developed a satisfactory system of counter induction which can be installed so as to eliminate the serious effect of this interference from the single phase distribution, and this is being tried out in actual practice on some of the branches of the New Haven system.

Electric Braking.

In the case of electrification of railroads having heavy grades, such as occur on mountain divisions, the use of dynamic braking is an important consideration, as it saves wear and tear on the mechanical braking equipment and adds to the safety of operation. The three-phase induction motor equipment is particularly applicable to dynamic braking, and control and operation is relatively simple. With this equipment the speed is automatically limited as long as the motors are connected to the line, because they cannot be speeded up but a slight amount above synchronism.

The direct current system can also be adapted to dynamic braking, although it is only fair to point out that this entails more complication with the control and does not furnish as positive a speed limit as the induction motor equipment.

In either case it is essential that the contract be maintained between the locomotive and the distribution system, and in a small installation it is advisable to provide a resistance load on the distribution system to consume the power generated by the dynamic braking.

In conclusion it can be stated that the economics of a particular proposed electrification can be studied and decided on broad grounds irrespective of system as the first cost and operating expense for an alternating or direct current installation will not usually be enough different to affect the result. The selecton of system will depend on extent of electrification, character of traffic and local conditions, and will be principally an engineering determination.

TERMINALS.

The electrification of steam railroads at terminals is frequently necessitated to satisfy the public. Laws are sometimes passed enforcing the elimination of the smoke nuisances, and these result naturally in electrification. Since terminals are usually located in or near the most congested portions of the cities they serve, the approaches necessarily pass through residential districts and therefore the presence of smoke is a source of much criticism and objection on the part of the public. On this account the elimination of such a nuisance is considered, even where action is not forced by law.

Terminal electrification is not, as a rule, decided upon for economical purposes. The reason for this is that the economies that actually do result from cheaper operating expenses and maintenance are swallowed up in paying the interest on the large investment required. This covers not only the cost of electrification itself, but also other improvements which are usually carried on at the same time, such as new stations, elevation of tracks, tunnels or cuts, etc. Another consideration that prevents economies from resulting is the fact that electrification of terminals does not eliminate or replace old equipment, but adds to it. This is because the territory covered by the improvement is over only a small area and the distance affected too short to bring about any reduction in the amount of steam equipment needed. If it were possible for the first electrification to be extended over one locomotive division, the resulting economies would be a determining factor to a much larger degree than has been the case in the past when only a few miles outside of the terminal has been electrified.

When terminals are reached by tunnels, the change from steam to electricity is almost a necessity regardless of economical consideration, on account of the danger of operation and the difficulty of maintaining a fast or frequent schedule due to the smoke. However, even where there are no tunnels, it is often found that electricity solves the problem, when the limit in space of a congested terminal or in the available trackage leading to it is reached. In cases of this sort, it is impossible to get the desired number of trains in and out over the given number of tracks, without considering electrification; the alternative for this condition lies in increasing track facilities by widening the right of way, or by providing tracks on two lines.

In congested city districts this plan is impracticable either because of lack of available space for extensions or prohibitive expense of obtaining additional space. The only way left is to increase the effectiveness of the existing terminals and trackage and the use of electricity as a motive power accomplishes this.

Electrification makes possible the operation of a larger number of trains over the same tracks with the same degree of safety. Acceleration is faster and the the absence of smoke makes it possible to run trains under a closer headway than with steam locomotives. Also many light engine moves are eliminated because there is no need for electric engines to make a trip for coal or water, or to the ash pit.

The ability to get more service out of a fixed number of tracks by means of electrification affects what was said above in connection with questions of economy. This is one case where even terminal electrification over a short distance might be an economical proposition, if the investment required for changing from steam to electricity is less than or even about the same as what would be needed for larger terminal facilities and increased trackage. If the investment were about the same, the consequent savings of electric operations and the advantages accruing from public satisfaction and advertising value would throw the balance in the favor of electrification.

SUBURBAN TRAFFIC.

Steam railroads having a considerable suburban traffic afford a very attractive opportunity for electrification. This kind of service operated by means of steam locomotives is by no means an economical proposition, and it is not practical to give a very frequent schedule over a large part of the day and the stopping places are necessarily a long distance apart. On account of these facts, trolley lines that parallel railroads form a very serious element in the way of competition. The trolley gives a frequent service, making many stops, and with its branches reaching a number of outlying points not touched by the steam line. Electrification of the steam road makes possible a rather close approximation to the advantages of the trolley, and therefore brings the competition on a more nearly equal basis. This is especially a case where the competing company operates one of the many high speed interurban trolley lines using multiple unit cars. Under such circumstances the steam road by electrifying the already existing tracks can practically duplicate the service of the parallel road. The through service can still be handled by steam engines until such time as it is advantageous to make a complete change to electric operation.

In this way also the traffic of a suburban road may be increased, for the improved service, with its large number of trains and its faster schedule, is bound to bring about this result. On branch lines where steam operation would be eliminated, there would be greater inducements for building up new sections on account of the absence of smoke and this would naturally lead to an increase in traffic.

The schedule of trains serving a suburban district can be greatly improved by electric operation. This is brought about by the quicker acceleration and as a rule the quicker braking that is possible. All this results from the use of multiple unit trains, where each car has its own motors, and the motive power available is thereby proportioned to the number of cars in the train. Also there is not the additional weight of a locomotive to be started and stopped, and therefore the entire weight of the train is made up of cars all of which are effective for the carrying of passengers. The same reasons explain why it is safe to maintain not only a faster schedule, but also a closer schedule, which allows a larger number of trains to be operated over a given number of tracks than would be practicable with steam.

The advertising value of the change from steam to electricity is considerable, as it is in reality satisfying public needs, or at any rate public desires. What the public wants very much, soon comes to be a necessity, and there is no doubt that more and more it is true that the public wants the electrification of steam railroads, especially on their suburban branches.

TUNNELS.

Next to the electrification of terminals, the principal field of application for electric traction has been the operation through tunnels. There have been many cases of existing steam railroad tunnels where the conditions of operation were almost impossible, due to excessive heat, smoke and steam. Heavy grades are a usual accompaniment of tunnels and further complicate the ventilation difficulties with steam operation.

The following example of steam operation is interesting. The Cascade tunnel of the Great Northern, situated about 100 miles east of Seattle, Wash., is something over two miles long with a constant grade of 1.7%. The difficulties of operating this tunnel by steam against the grade were enormous. On arriving at the tunnel locomotive fires would be drawn and new fires built with a special coal. An hour or more would be spent coking these fires and getting them into shape to make the run through the tunnel. The train would then be cut in two unequal parts, the lighter part being first taken through by a helper engine stationed regularly at the tunnel and the heavier part by the two road engines, one pulling and one pushing. The temperature of the air in the cab of the second engine was almost unbearable, sometimes going as high as 200° F. Often it was impossible to maintain steam in the rear engine on account of the vitiated condition of the air, and the train would have to be cut in two and the rear part run out, down the grade. After one train had gone through it would be twenty minutes to an hour before another could enter. In the event of a change in the wind the gases would pocket in the tunnel and sometimes it would be three hours before it was safe to start another train through.

These difficulties have been overcome by operating trains electrically, either interchanging steam and electric locomotives or hauling the complete train with its steam locomotive dead. In other cases, tunnel construction has been used where electrification was part of the operating plan at the outset. In fact, it is recognized that many such cases would not be an operating possibility without electric traction, for instance the river tunnels entering the Pennsylvania Terminal in New York.

Aside from the importance of this feature there have been a number of instances where a single track tunnel constituted the capacity limitation of a railroad line. The well known facility of increasing traffic movement by higher schedule speed especially on grades and by hauling heavier trains with electric traction has made it possible to accomplish the desired end without recourse to double tracking a tunnel section. This is the main reason for the electrification of the Norfolk & Western.

The greater number of tunnels which have been changed from steam to electric operation have been decided upon for the purpose of increasing safety of operation, both as to visibility of signals and lessening the discomfort of heat and danger of gas asphyxiation. The Cascade, St. Clair, Hoosac, Detroit River and Grand Central tunnels are striking examples of this condition. The double track Hoosac tunnel handled double the traffic after electrification.

MOUNTAIN DIVISIONS.

A number of railroads have considered the electrification of certain mountain districts—where numerous and heavy grades predominated. There are several reasons favoring electric traction for such divisions.

First: The heavy grades impose a slow schedule for steam operation and either the large Mallet locomotives must be used for freight traffic or the maximum train weight kept below 1,200 tons. The electric locomotive can supply an excess tractive effort for moderate length grades and thus maintain speed. By using two or three electric units operated as one, the equivalent power of the largest Mallet is obtained but the crew cost and maintenance expense will be in favor of the electric. It is entirely practicable to handle 2,000 to 4,000 ton trains with the electrics.

Second: Usually the mountain divisions will contain grades of 22% or more which are operated as helper districts. The cost per mile for this steam helper service is usually excessive. Even if electric helpers are required, the flexibility of operation and better speed obtainable will make it possible to reduce the cost of this service.

Third: Tunnels are a common accompaniment of mountain lines and it has been pointed out how safety and economy favor the electrification of same.

Fourth: Mountain districts, by the nature of the country, usually contain water power sites which can be used for hydroelectric power supply, thus making it possible to obtain operating power at relatively low cost.

Fifth: The forest tracts traversed are subject to fires started from steam locomotives. This condition is so serious on some roads that an extensive fire patrol and fighting force has to be kept in service. This expense and fire damage would be saved by electric operation.

Sixth: Electric traction makes dynamic braking possible, thereby increasing safety and saving wear and repairs on brake equipment.

The Chicago, Milwaukee & Puget Sound; Butte, Anaconda & Pacific, and the Norfolk & Western electrifications are the best examples under this classification.

SINGLE TRACK ROADS.

It is a demonstrable fact that more traffic can be handled electrically than by steam on account of facility of train movement and ability to maintain a higher schedule speed without increasing the maximum speed.

It can be shown, in the case of a single track road operating at full capacity, that electrification will enable it to handle additional traffic, thus postponing double tracking. The fixed charges saved on the cost of double tracking for this period may properly be credited to the electrification annual expense in calculating the economics.

PASSENGER AND FREIGHT YARDS.

Some of the terminal electrifications around New York have necessitated the extension of the system to large yards. The Sunnyside yard of the Pennsylvania, containing 37 miles of track and covering 153 acres, and the Mott Haven yard of the New York Central having 15 miles of electrified track, take care of the passenger equipment for their respective terminals. All switching in these yards is done with electric locomotives supplied from 600 volt third rail.

The New Haven system has electrified all its terminus freight yards on the Harlem River branch. The 11,000 volt overhead catenary is installed throughout, the single messenger cables being supported from cross catenary spans covering a number of tracks between poles. The Harlem River yard comprises 21 miles of track and the Westchester yard about 15 miles of track. The main

classification yard at Oak Point has a trackage of 36 miles. The movements in those yards are handled by special electric switcher locomotives weighing 80 tons.

There has been some controversy with the labor unions regarding the danger to trainmen from the overhead catenary in these yards, but they have been operated successfully for over a year now under a strict rule forbidding trainmen to work on top of the cars.

The several yard electrifications referred to above are the best examples in this country.

In this connection it might be mentioned that the comprehensive railroad terminal and yard improvements now being considered for the City of Chicago are meeting with serious objections on the part of organized labor against any form of electrification using third-rail or overhead trolley. There is no justification for this extreme view and operating experience with electrifications will not sustain it.

POWER SUPPLY.

The supply of power for railroad electrification will usually be obtained by (a) purchase from a power company, (b) steam plant, or (c) hydro-electric plant, built and operated by the railroad.

It is the tendency for power companies to operate an extensive system of transmission supplied by several generating stations. There are many locations in the United States where such systems are in operation. A large power system will usually have a good diversity factor and can afford to make very favorable rates. The several generating stations and different feeding in points of the transmission increases the reliability of service. Therefore, where a suitable power supply is available it will usually be cheaper and more reliable for the railroad to purchase its power for electrification rather than generate it. This will also relieve it of a large initial investment and the necessity of organizing and operating an entirely separate department.

Contracts for hydro-electric power have been made on a basis of $20 to $30 per horsepower per year. One electrification purchases power for .5 cents per K. W. H. Usually these power contracts provide for minimum and maximum demands and the rate depends on power factory and equivalent load factor.

The Erie, Great Northern, Butte, Anaconda & Pacific, Michigan Central (Detroit Tunnel), St. Paul and some others purchase all power for electric traction.

If a railroad supplies its own power for electrification from a steam station and has no other load, it will operate at a low load factor, unless a dense and uniform traffic is handled, resulting in a large installation for a low average load. This means poor economy. A large steam turbine plant, favorably located outside of a city, with coal at $2.25 per ton and a load factor of 45% can make power for about .7 cent per K. W. H., including fixed charges.

A hydro-electric plant will usually require a larger investment and unless there is more than one plant, with ample water supply, a steam standby station is almost a necessity; thus again putting a burden on the cost of power.

The economics of power supply for an electrification is of the utmost importance and the particular situation under consideration should be carefully analyzed by a competent engineer familiar with power generation and costs.

CONSTRUCTION COST AND ANNUAL EXPENSE.

The construction cost of an electrification including power plant will not be affected greatly by the system adopted but the character and extent of the installation will have the greatest influence. For instance, in a concrete case that has been analyzed the total cost of electrification for a 145 mile division was about six times the cost of electrifying a 12 mile section in the same division for the same passing traffic. This comes about because of the relatively higher cost of power plant for the short section, and the better mileage obtained from locomotives having a division run, thus requiring a proportionately smaller number.

The operating costs will likewise be in favor of the extensive installations even in a greater proportion than the first cost. The fixed charges, of course, will bear the same relation as the construction cost.

The overhead catenary cost per mile is usually less than third rail. Similar construction is used for high voltage direct current and single phase catenary, the amount of insulation being the principal difference.

The direct current systems will require substations containing rotative apparatus and the construction cost and operating expense will be considerably more than for the outdoor transformer substations with the alternating system. If 60 cycle power is purchased for an alternating current electrification it will be necessary to use sub-stations with frequency changer sets in order to supply 25 cycle power.

LOCOMOTIVE MAINTENANCE.

The cost of locomotive maintenance and repairs per mile operated is without doubt in favor of the electric unit as compared with the steam. There are two reasons why this result is obtained; first, the absence of boiler, fire box, and reciprocating equipment in the electric locomotives materially reduces the repairs; second, the greater mileage obtainable with electric locomotives results in a lower traffic average cost.

Depending upon the character of the traffic and the operating conditions under which the locomotives are used, the cost of maintenance for electric units usually varies from 4 to 8 cents per locomotive mile. Some of the Baltimore & Ohio tunnel electric locomotives have shown an annual maintenance cost as low as 3 cents per locomotive mile. This must be considered an unusually good result and is probably obtainable because of the character of the service and the great annual mileage, which averaged over 350 per day.

The Pennsylvania, New York Central and New Haven locomotives have been operated at a maintenance cost ranging from 4½ to 6½ cents per locomotive mile.

The cost of steam locomotive maintenance varies very widely and it is not safe to make general comparisons. However, reliable data has been obtained on one large railroad electrification which indicates that with electric and steam locomotives handling the same character of traffic and operating under similar conditions, the cost of maintenance and repairs per locomotive mile is just about one-half as much for the electric as for the steam locomotives.

ECONOMICS OF ELECTRIC TRACTION.

Various reasons for the electrification of portions of steam railroad have been given and in many cases the necessities of the situation governed the decision. As an alternative to double-tracking, tunnel enlargement, grade reductions, increase in terminal space, or other large expenditures required either by traffic conditions or legislative enactment, electrification will usually show an economic saving. That is, the recognized decrease in maintenance and repair cost of electric locomotive equipment, saving in crew wages, and reduction in cost of power will more than counterbalance the additional operating cost of electric transmission and distributing systems. In these cases the first cost of electrification is offset by the saving in not making the other improvement. In this connection it should be borne in mind that the first cost of electric locomotives—which will amount to about one-third of the total cost of an electrification, including power plant—should not be treated wholly as an electrification investment, because they can usually be considered as a normal addition to the motive power equipment of the road. In any case there should be credited against the cost of the locomotives the cost of equivalent steam locomotives which do the same work, assuming that the railroad is large enough to absorb the steam locomotives displaced.

The cost of handling freight trains can usually be reduced by the higher schedule speed obtainable due to the overload characteristics and high tractive effort at low speeds of electric locomotives on grades, and the larger train units which can be operated, thus reducing the number of trains for a given traffic. It is also a fact that electric locomotives can make from 50% to 100 more mileage per year than steam locomotives due to facility of operation, less round house time and fewer major repairs.

Railroad electrification for straight economy over steam operation, where there are no contingent improvements saved which can

be credited to cost of electrification, will not usually show sufficient net saving in expenses to provide for interest on the investment and amortization. Of course all conditions must be taken into account and a detailed study made in any particular case to arrive at a final answer as to the economies. For instance, as a power plant represents about one-third the cost of an electrification, the purchase of power may affect the result and an unusually cheap power supply, such as may be obtained from hydro-electric developments in certain localities, will often make electrification prove economical.

Generally speaking, the savings in operation due to electrification of a steam railroad result from two principal causes; first, that due to reduction in fuel consumption, locomotive maintenance and repairs, engine house expenses and other detail costs; and, second, that due to reduction in number of freight trains to handle a given traffic.

The reduction in the amount of coal hauled for locomotive purposes, where a steam plant is substituted, would materially affect the traffic operation. This hauling of coal would be entirely eliminated where power was purchased or generated in hydro-electro plants.

Electric operation of passenger trains provides cleaner and faster service which is attractive to the public and results in greater traffic, increasing the gross earnings.

A TALK TO YOUNG MEN.

High lustered varnish, comfortable upholstery and plenty of shining accessories don't add to the horsepower of an automobile, but they help to sell it.

Neat and well chosen clothes, a pleasant and courteous manner and the ability to make people like you don't make you a more skillful workman, but they attract favorable notice and win "boosters."

An unpleasant personality has kept many a bright young man from rising because he repelled people whose good word and active interest in him would have resulted in advancement.

Don't fool yourself with the idea that you don't need friends. Don't saturate yourself with the impression that the effect your personality has on others doesn't matter. In this great battle of life if you needlessly make enemies you fight against an army. If you make friends you fight with an army. Whosoever is not with you is against you.

The only man who is fairly safe in nursing a grouch is the boss; and even he would drop it like a hot stone if he realized how it militated against him—how it cuts down the efficiency of his force by making his men work in an atmosphere of depression instead of in the sunshine of enthusiasm.

Having a pleasant personality does not mean being a wild "good fellow." It means simply presenting the best possible appearance, and having the most pleasing possible effect on your fellows. Not to inflict yourself upon them, but to impress yourself upon them. In other words, to make the world "like" you.—*Personality.*

Since the outbreak of war in Europe the government has shipped nearly 200 tons of gold, worth about $99,000,000, from Philadelphia to New York without cost for railroad transportation.

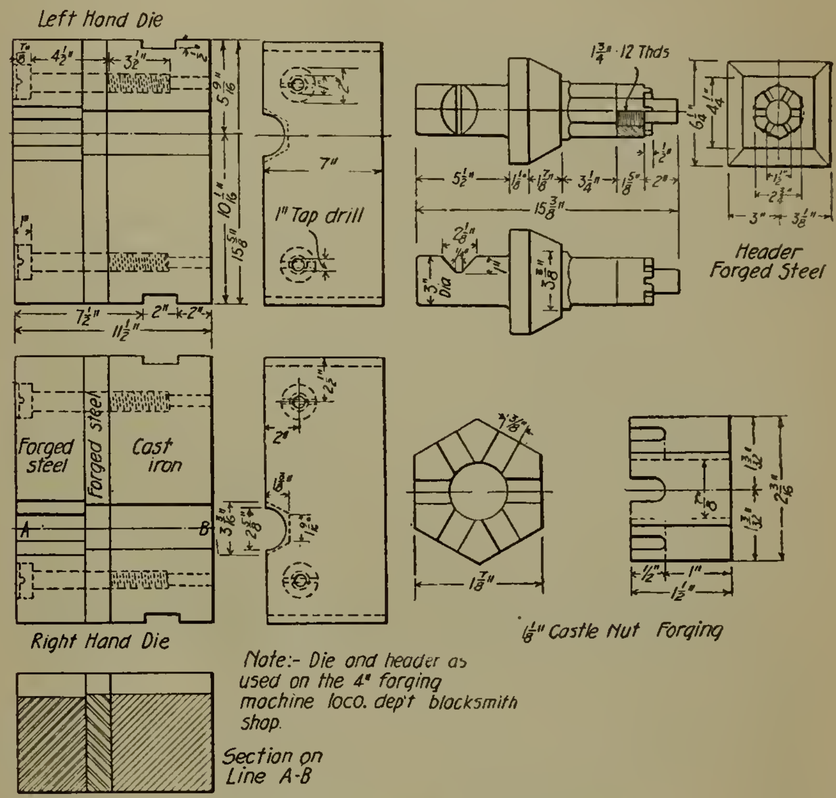
This was accomplished by sending the gold as parcel post. Railway mail pay provides compensation only for carrying the ordinary mail and includes no specific allowance for such extraordinary service as handling gold transfers for the Treasury Department.

Not a single passenger out of the 188,411,876 carried in 1914 on all of the 26,198 miles of track of the entire Pennsylvania system was killed in a train accident. Reports compiled for all the lines of the system, with figures for the last month estimated, show that Pennsylvania passenger trains traveled 67,389,381 miles in 1914. More than 3,000 trains were operated every day—more than a million trains in the year.

FORGING CASTLE NUTS AND GREASE CUPS.

By A. Bennett, Genl. Fmn. Blks., C., M. & St. P. Ry.

At the Milwaukee shops of the Chicago, Milwaukee & St. Paul we make castle nuts on three different machines, namely 4-inch, 2-inch and 1½-inch. The largest nut we make is 3" on the 4" machine; the smallest is ⅝", which is made on the 1½" machine. They are made from round bar iron; are shaped, slotted and punched in one blow of the machine and then are upset to size in the dies and punched and slotted with the header.



Dies and Headers for Castle Nuts.

The dies we make of cast iron, faced with old axle-steel which we heat-treat. The headers are made from old axle steel with tool steel dowls doved-tailed in the end for shaping the slots in the nut. The punch is made from vanadium steel, heat-treated and tapped in the header to punch the hole in nut. I consider this one of the best forgings made in one operation on the Ajax machine.

Rough and Finished Forgings.

We make our grease cups from 2" round cold rolled steel in one blow, on the 4" machine. These cups have two different size holes, 1⅝" dia. x 1¼" deep and 1⅛" dia. x 1⅜" deep. The outside is shaped to 2⅜" hexagon, 1¼" long by 2⅛" dia. 1⅜" long.

We cut the 2" steel in 3 foot lengths and forge the cups, which we cut from the bar with a shears attached to the side of the machine. These cups must be forged to size as there is no finish only to cut the thread. We use coke for fuel and turn out about 40 per hour.

GRINDING THE DRILL POINT.

No drill, however carefully designed and tempered, can give anything like efficient service unless it is properly ground at the point. This means that both cutting edges must be at the same angle to the axis of the drill (59° is recommended as the best angle for ordinary purposes) and of exactly the same length; this will, of course, bring the center of the cutting edges, or point, in the true center of the drill and cause it to produce a round, smooth hole. Fig. 1 shows the point central but the angles of the cutting edges different. Fig. 2 shows the angles equal but the cutting edges of unequal lengths. Fig. 3 shows the severe conditions under which the drill will be laboring when both the angles and length of the cutting edges are different. In all these cases the hole will be too large, one cutting edge will be doing more than its share of the work, the side of the drill opposite that cutting edge will be crowded against the wall of the hole so as to get undue wear and the support which the drill should receive from the metal on which it is operating will be seriously impaired.

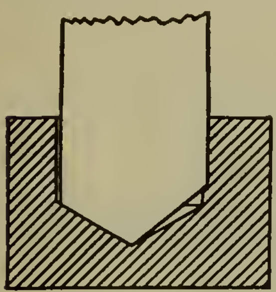


Fig. 1.

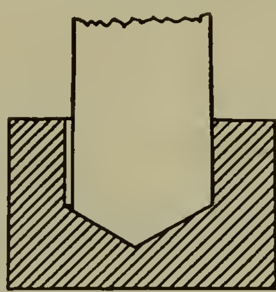


Fig. 2.

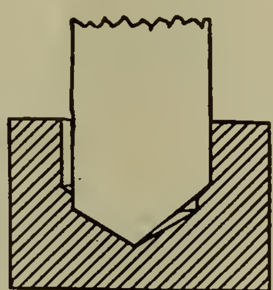


Fig. 3.

Another very important thing to be considered in drill grinding is the lip clearance, or proper contour of the point back of the cutting edge. To get this correct, even on a machine, is a difficult problem. We are indebted to the Worcester Polytechnic Institute for their permission to reprint the following technical analysis of the theory of lip clearance on a twist drill.

"Every portion of a drill lip when at work travels in a helix of its own. No two of these helices are of the same diameter, yet all have the same pitch because all parts of the drill advance equally.

"The 'clearance' at any given point in the cutting lip is determined by, and bears a constant relation to, the tangent, at that particular point, of its own individual helix.

"Therefore, near the point of the drill where the helices are of smaller diameter (their pitch remaining the same), these tangents form acuter angles with the axis of the drill than where the diameters are large, as near the outer corner of the lip. The clearance being governed by these angles must likewise be steeper near the point of the drill than it is farther out on the lip.

"In order to grade the clearance properly along the drill lip, as above outlined, from point to periphery, and curve the back side of the cutting edge so that maximum endurance and strength, consistent with free cutting, are preserved at all points, it is necessary that every portion of the cutting lip should, while being ground, rock against the grinding wheel in a path very similar to that in which it travels when at work.

"If while at work those portions of the drill lip near the point travel in shorter paths and smaller circles than portions near the

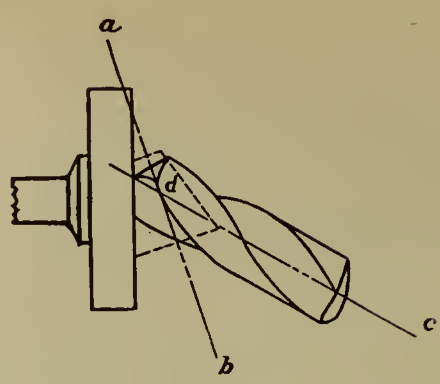


Fig. 4.

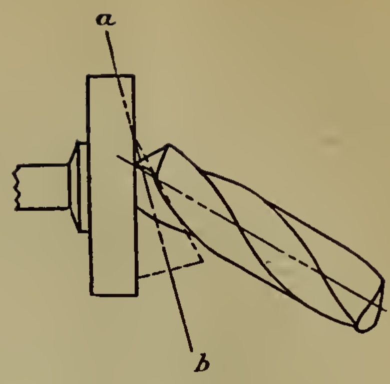


Fig. 5.

outer corner of the lip, then this condition should exist when the drill is being ground."

Fig. 4 shows the type of grinding machine that gives the form of drill point just described, which is the one we have adopted as a result of our experience. This form is a segment of a cone, the axis of which is on the line a-b at the angle bdc to the axis of the drill. The dotted lines show the complete frustum of the cone, in the position which our experiments showed to be about right for the best all around results.

In Fig. 5 the axis of the cone intersects the axis of the drill too near the drill point. The curvature near the center of the drill is therefore too quick, and we found that a drill ground in this manner consumed about twenty per cent more power than the same drill ground as illustrated in Fig. 4.

Fig. 6 illustrates the point whose surface is a segment of a cylinder, and Fig. 7 represents the inverted cone with axis on line a-b; dotted lines show the frustum complete.

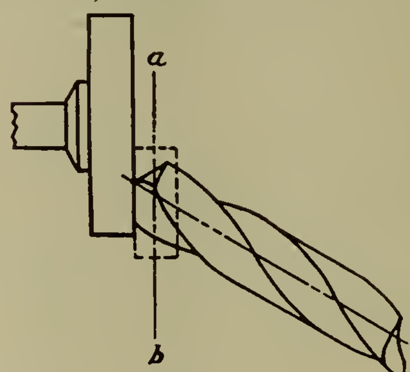


Fig. 6.

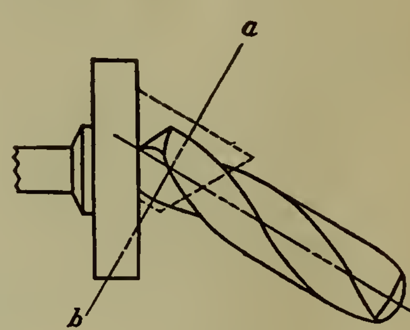


Fig. 7.

In both these forms of point (Figs. 6 and 7), the radius of curvature is too small at the outside, or periphery, compared with that at the inside, or center. As a result, when the contour of the point at the periphery is approximately correct it will be too flat at the center, and unless the angle of lip clearance is greatly increased, the heel near the center will drag. If the angle is increased to correct this fault the cutting edge near the center

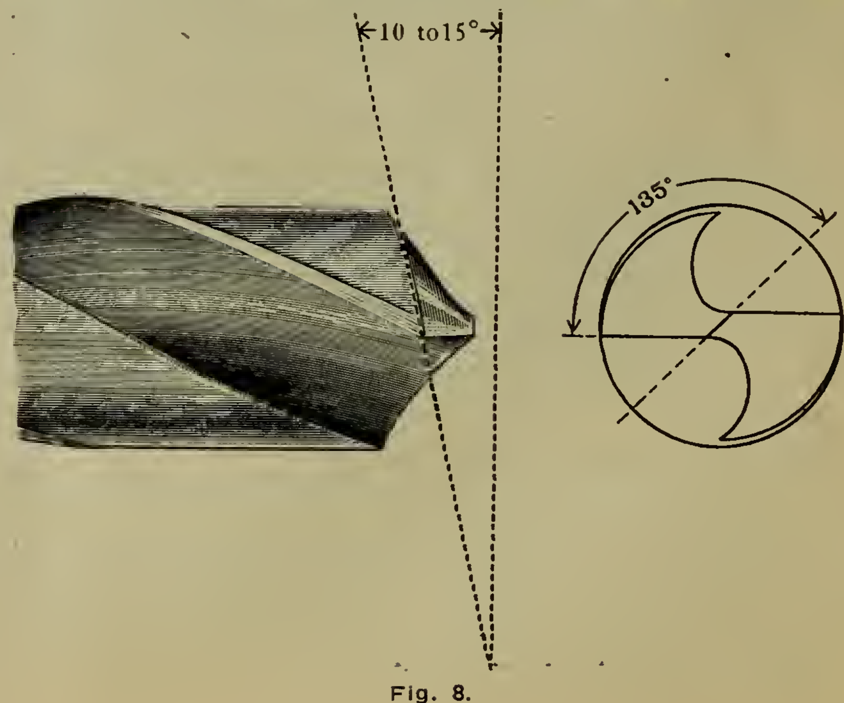


Fig. 8.

will be so fine (i. e., have so little backing) as to endanger its chipping out—frequently causing the drill to break.

Of no less importance in drill grinding is the angle of lip, clearance not to be confused with the contour of the point just dealt with. Ten to twelve degrees has proven to be the best angle at the periphery for a drill ground as in Fig. 4, but this should be increased as the center of the drill is approached until the line across the center of the web stands at an angle with the cutting edges of from 120 to 135 degrees, according to the feed.

For heavy feeds in soft material the clearance angle at the periphery may be increased to 15 degrees, but care should then be taken that the angle at the center is as shown in Fig. 8. The grinding machines producing the form of point shown in Fig. 4 automatically take care of this increase when properly adjusted, which is one of their strongest recommendations.

Lack of sufficient clearance at the center of the drill is the principal cause of splitting drills up the web, and grinding them as shown in Fig. 8 is the most effective.—*Drill Chips.*

WESTINGHOUSE ACCIDENT AND RELIEF PLANS.

The Westinghouse Electric & Manufacturing Company has just issued a preliminary statement of its sickness and accident relief, accident compensation and service pensions on which its officers have been working for over a year.

The plan includes three separate and distinct features:

1st. Extension of the present relief department.

2nd. An accident and compensation plan.

3rd. Service pensions.

The privileges of the relief department are open to every employee, male or female, regardless of age, position or location, upon payment of small monthly dues.

The company pays the entire expense connected with the operation and maintenance of this department, the dues being reserved wholly for the payment of benefits (proportional to wages) for sickness and accident arising from causes other than employment. In the event of death the amount paid from the dues will be duplicated by the company, which will also meet any deficit that may arise.

Benefits will continue as long as disability lasts, or until the age of 70 years is reached, when pensions will then be granted.

The accident compensation fund is maintained entirely by the company for the benefit of all employees, male or female, whether they belong to the relief department or not. This plan covers the payment for disability due to accident, or for death resulting from accident, while at work as an employee, and makes provision for both total and partial disability. In case of total disability, the company will pay as long as the disability lasts, even for life, two-thirds of the average wages received, and for partial disability, two-thirds of the reduction in the earning capacity of the employee, even though the employee should eventually leave the service of the company. In case of death, the company will immediately pay the dependents, or next of kin, $150, as explained under the provisions of the plan, as a pension to the widow or dependent husband or children under 16 years of age.

Medical, surgical and hospital expenses under the direction of the company's medical officers will be paid during disability from such accidents.

Employees of the company shall be retired at the age of 70 years, and those who at the time of such retirement are members of the relief department, and have completed at least twenty years of continuous service, are to be granted a pension amounting to one per cent of the average monthly wages during the last ten years of employment for every year of continuous service, with a minimum of $20 per month and a maximum of $100 per month.

Upon the death of the pensioner, one-half of the pension will be paid to the widow until remarriage, providing marriage occurred at least ten years before the granting of the pension. For the support of each child under 16 years of age, and for each wholly dependent grandchild under 16 years of age, one-fourth of the pension will be paid until they reach the age of 16 years.

The president may, at his discretion, retire any employee between the ages of 60 and 70 years who has been in the service the required time, and he may increase any pension for specially meritorious service, by 25 per cent, but not beyond the maximum pension of $100 per month.

In those states already having workmen's compensation laws, as in the case of New Jersey and Ohio, where the company also maintains plants, such laws may be substituted in whole or in part. Where the provisions of the Westinghouse plan are more liberal, these will generally prevail.

Secretary Redfield of the Department of Commerce says: "If you want prosperity, do your share to bring it, and do it now. Get that addition to your shop going; it will cost you less today than six months hence. Is trade a bit dull at the works? Get those improvements begun. Prices are low and likely to rise. You've been thinking of that contract work; better start it before things get the start of you. This country slows down a bit now and then, but it never stops growing."

The Baltimore & Ohio granted a large number of the road's employes a holiday on New Year's Day, in accordance with the general observance of the day. Local freight houses remained closed except for the delivery of perishable shipments, and just as few trains as practicable were run.

New Books

VALUATION OF PUBLIC SERVICE CORPORATIONS. By Robert H. Whitten, Ph. D. Buckram, 1,500 pages, 6x9 inches, two volumes. Published by the Banks Law Publishing Company, 23 Park Place, New York. Price $11.

The development of the economic and engineering features connected with the valuation of public service corporations has been very rapid within the last ten years, and for those interested in this line of work it has proven very essential that notes regarding the decisions of courts and commissions should be prepared and arranged in such form that ready reference may be had to any one of the many features involved.

Dr. Whitten in this book has attempted to perform this service and has accomplished his purpose admirably. The book segregates the discussions in as complete a manner as seems practicable, citing features of the valuation of public utility property for rate making purposes, among such features being the questions of valuation of land, unit prices, overhead charges, piecemeal construction, working capital, bond discount and depreciation, going and franchise value, rate of return, etc. In handling these matters Dr. Whitten very wisely advances no personal opinions based upon personal judgment only, as is so frequently the case with authors upon this subject, but limits his considerations to a statement of court and commission decisions, and makes his deductions from said decisions.

To the practical railroad man the book should prove of considerable interest, since the matter of railroad rates, capitalization, income and expenses are so inextricably involved with the practical operation of railroad systems that it behooves every one of us who is interested in the welfare of these great utility organizations to familiarize himself and take a personal interest in the matter of their regulation by state and interstate regulating bodies. While the book treats of this subject in a technical sense primarily it has apparently been the aim of the author to make his statements as simply as is consistent with an accurate presentation of the facts.

Volume I of the book was originally issued in the spring of 1912, and discussed the theory and practice of valuation as it had developed up to that time. Volume II was issued in the summer of 1914, and contains much additional information regarding the development of the theory and practice of such matters since the issue of the first volume. The book is not

limited to a discussion of any particular class of public utilities but covers quite fully the entire field.

The author is connected with the New York Public Service Commission for the First District, and in addition is an expert investigator for the department on the regulation of interstate and municipal utilities of the National Civic Federation.

The book is recommended unqualifiedly to those of our readers who are at present unfamiliar with the manner of public service valuation, as a book worthy of careful study, as well as to those of our readers who are more or less experts along these lines, as a book of great value for reference purposes.

TRAVELING ENGINEERS' ASSOCIATION. Report of the twenty-second annual convention. Leather, 6x9 inches, 454 pages, illustrated. Published by the secretary, W. O. Thompson, Buffalo, N. Y.

The annual meeting of this association for 1914 was held at the Hotel Sherman, Chicago, Ill., on September 15, 16, 17 and 18, and it fully lived up to the motto of the association which is "To improve the locomotive service of America." This volume contains the results of a year's work of the association, and the contents are of value to all interested in locomotive operation and maintenance. Among the subjects taken up are "Black Smoke and Its Relation to the Cost of Fuel and Repairs," "Operating Locomotives at Maximum Efficiency," "Mechanical Stokers," "Care of Brake Equipment," "Speed Recorders," "Chemistry of Combustion." The volume is arranged in the standard form in which the proceedings have been published in years past.

RAILWAY ROLLING STOCK APPLIANCES AND EQUIPMENT. Arranged by Parker Cook, Victor building, Washington, D. C. Paper, 4x6 inches; 16 pages. Limited free distribution

This booklet should be of assistance to those interested in or working on inventions pertaining to railway rolling stock, as it contains a complete classification of the patents which have been granted in this field. It is divided into classes and sub-classes, and after each classification is shown the number of patents granted. This enables one to get a line on the work which has previously been done along any certain lines.

Personals

H. F. Staley has been appointed superintendent of motive power of the *Boyne City, Gaylord & Alpena*, with office at Boyne City, Mich.

George F. Fisher succeeds E. H. McCann as master mechanic of the *Cape Girardeau Northern*, with office at Cape Girardeau, Mo.

J. Duguid has been appointed assistant mechanical superintendent of the *Central Vermont*, with office at St. Albans, Vt.

H. H. Estrup has been appointed general foreman, car department, of the *Chicago & Eastern Illinois* at Dalton, Ill.

F. W. Anderson succeeds A. W. Harvey as shop foreman of the *Chicago & North Western* at Pierre, S. D.

J. Gorman succeeds T. Dwan as car foreman of the *Chicago Great Western* at Mason City, Ia.

H. F. Patmor succeeds George McLean as car foreman of the *Chicago Great Western*, with office at Oelwein, Ia.

J. I. McConnell succeeds R. N. Dodge as foreman car department of the *Chicago, Milwaukee & Gary*, with office at Rockford, Ill.

H. A. Enockson, locomotive foreman of the *Chicago, St. Paul, Minneapolis & Omaha*, has been transferred from East St. Paul, Minn., to Altoona, Wis.

Thomas P. Devitt succeeds H. A. Euockson as locomotive foreman of the *Chicago, St. Paul, Minneapolis & Omaha* at East St. Paul, Minn.

A. Lindboe succeeds F. R. Jones as locomotive foreman of the *Chicago, St. Paul, Minneapolis & Omaha* at Omaha, Neb.

O. S. Jackson has been appointed general superintendent of the *Chicago, Terre Haute & Southeastern*, having jurisdiction over both operating and mechanical departments. His office remains at Terre Haute, Ind. The position of superintendent of motive power has beeu abolished.

A. C. Schneider has been appointed general foreman of the *Cincinnati, New Orleans & Texas Pacific* at the Ferguson shops, succeeding W. A. Ford.

N. M. Barker has been appointed master mechanic of the *Copper Range* in charge of the locomotive car and supply departments, vice John A. Berg, assigned to other duties. His office is at Houghton, Mich.

M. R. Feeley succeeds W. McIntosh as general foreman, motive power department, of the *Delaware, Lackawanna & Western*, with office at Kingsland, N. J.

W. G. Davis has been appointed general foreman of the *Detroit, Toledo & Ironton* at Springfield, O., succeeding J. A. Hannigan.

B. Powers succeeds E. G. Sheldon as general foreman of the *Detroit, Toledo & Ironton*, with office at Jackson, O.

E. West succeeds B. Powers as road foreman of engines of the *Detroit, Toledo & Ironton* at Springfield, O.

D. G. Madden has been appointed supervisor of locomotive operation of the *Erie* at Cleveland, O., succeeding J. J. McNeill.

E. E. Blake succeeds L. Barnes as road foreman of engines of the *Erie* at Susquehanna, Pa.

J. J. McNeill succeeds P. K. Sullivan as road foreman of engines of the *Erie* at Cleveland, O.

A. Copony, master car builder of the *Grand Trunk*, has been transferred from Port Huron, Mich., to Elsoon, Ill.

R. Woods, foreman painter of the *Grand Trunk*, has been transferred from Port Huron, Mich., to London, Ont.

E. A. Humphrey succeeds C. L. Daugherty as electrical engineer of the *Great Northern*, with office at St. Paul, Minn.

F. J. Kearney, locomotive foreman of the *Great Northern*, has been transferred from Superior, Wis., to Williston, N. D.

Edward Riley succeeds F. J. Kearney as locomotive foreman of the *Great Northern* at Superior, Wis.

R. E. Molt, locomotive foreman of the *Great Northern*, has been transferred from Interbay, Wash., to Gold Bar, Wash.

J. O'Brien succeeds R. E. Molt as locomotive foreman of the *Great Northern* at Interbay, Wash.

Frank W. Taylor has been appointed superintendent of motive power of the *International & Great Northern*, with headquarters at Palestine, Tex., succeeding C. H. Seabrook, resigned.

Norman Bell has been appointed master mechanic of the *Illinois Central* at Waterloo, Ia., vice Frank W. Taylor resigned to accept service elsewhere.

G. A. McGee has been appointed master mechanic of the *Lorain, Ashland & Southern*, with office at Ashland, O. He succeeds William Austin.

G. D. Harris succeeds B. D. Richardson as master mechanic of the *Midland Valley* at Muskogee, Okla.

C. E. Stone has been appointed general car foreman of the *Missouri & North Arkansas*, with office at Harrison, Ark.

Harry H. Trenton has been promoted to general foreman of the *Missouri Pacific* at Kansas City, Mo., succeeding William Donahue, resigned. Mr. Trenton was formerly gang foreman.

Charles Emerson has been appointed road foreman of engines of the *Northern Pacific*, with office at Duluth, Minn.

J. K. Brassill has been appointed acting superintendent and general master mechanic of the *Northwestern Pacific*, with office at Sausalito, Cal.

F. G. Grimshaw has been appointed assistant engineer of electric equipment of the *Pennsylvania*, with office at Pittsburgh, Pa.

E. E. Griest has been promoted to master mechanic of the *Pennsylvania* at Fort Wayne, Ind. Mr. Griest was formerly assistant master mechanic at this point.

F. T. Huston has been appointed assistant master mechanic of the *Pennsylvania* at Fort Wayne, Ind., succeeding E. E. Griest.

John O. Boyer has been appointed road foreman of engines of the *Philadelphia & Reading*, with office at St. Clair, Pa.

A. D. Brice has been appointed master car builder of the *San Antonio & Aransas Pass*, with office at Yoakum, Tex., vice W. T. Cousley, resigned.

E. H. McCann succeeds J. H. Ruxton as superintendent of motive power of the *San Antonio, Uvalde & Gulf*, with office at Pleasanton, Tex.

H. Cramer has been appointed supervisor of locomotive operation of the lines of the *Seaboard Air Line* south of Columbia. His headquarters are at Jacksonville, Fla.

T. U. Brown has been appointed supervisor of locomotive operation of the lines of the *Seaboard Air Line* north and west of Columbia, with headquarters at Hamlet, N. C.

G. R. Bissett has been appointed road foreman of engines of the *Seaboard Air Line*, with office at Savannah, Ga.

A. E. Hopkins, road foreman of engines of the *Seaboard Air Line*, has been transferred from Hamlet, N. C., to Americus, Ga.

W. W. Payne has been appointed road foreman of engines of the *Seaboard Air Line* at Hamlet, N. C., succeeding A. E. Hopkins.

W. J. Shreve has been appointed superintendent of motive power of the *South Dakota Central*, succeeding C. O. Destiche. His office is at Sioux Falls, S. D.

New Literature

T. A. Willson & Co., Reading, Pa., have issued circulars descriptive of their new goggle, which is especially designed for light work to meet the requirements of machinists and grinders. In these goggles the safety flange used in the heavier styles for chippers, etc., has been eliminated. Also the side shields are much lighter and of finer mesh and the temples are on the outside of the shields.

* * *

The Edwards Mfg. Co., Cincinnati, O., illustrates and describes the Edwards general purpose truck in a folder recently published. These are for handling heavy freight by railroads and steamship lines and for warehouse and heavy factory use.

* * *

Bulletin No. 34-K of the Chicago Pneumatic Tool Co., Chicago, is devoted to class N-SO and N-SG fuel oil, and gas-driven compressors and their application to the unit system of air power plants.

* * *

"Asbestosteel for Roofs and Walls" is the title of an attractive bulletin just issued by the Asbestos Protected Metal Co., New York. This material consists of sheet steel which is protected from corrosion by having a uniform coating of asphalt on both sides, which in turn is protected from fire and weather exposure by a layer of hardened and waterproofed asbestos. It is made corrugated so that it can be used in connection with concrete for roofs and plaster for walls.

PRIZES FOR A TOOL-STEEL NAME.

A good trade name is a great help in advertising a product. Realizing this, the firm of Joseph T. Ryerson & Son, Chicago, are offering a prize of $100 for the best name to cover the tool steels which they are now selling. This firm has been selling a complete line of tool steel for many years, having an outside manufacturing connection. They have been manufacturing their own steel for some time with success, using the old names coupled with Ryerson.

The contest closes at noon on April 15, the officials of Joseph T. Ryerson being the judges. In addition to the first prize, 300 reference books will be given for the next best 300 names submitted. Full particulars with regard to the contest may be had from the firm.

SENTINEL PYROMETERS AND PASTES.

A new method for measuring temperatures wherever heat is applied has just been developed by the Carl Nehls Alloy Co., 248 Brush St., Detroit, Mich. This consists of different kinds of metallic salts which are made into molecular mixtures that will melt down at different temperatures, throughout the range between 220 and 1,330 degrees Centigrade. Practical means have been devised for using them in place of the more costly pyrometers and they are also very useful for checking pyrometers. In the latter case a cylinder of the salts is placed at the end of the thermo-couple and when it melts the pyrometer should read the same as the temperature marked on the salts.

One way is to cast them into solid cylinders, $7/15$ inch in diameter and $3/4$ inch long, as shown by those standing on end in the accompanying illustration. Each one is wrapped in a paper, on which is printed its correct melting temperature in degrees, centigrade, as shown by the samples laying down. For all temperatures below 932 degrees, F., these "Sentinel Pyrometers" can be used in an air-tight glass tube, such as is shown, in the center. The salts can then be used over and over again. By using the small porcelain saucers shown, the salts do not run to waste and litter up the place where they are used. This also enables them to be used several times, as the salt melts each time the temperature raises above the one marked on the cylinders and becomes solid again the moment the temperature falls below this degree.

Sentinel Pyrometer Pastes and Salts.

These salts are also made up in the form of a paste. Enough to make several hundred determinations is packed in the tins shown. Pastes with various melting temperatures can be daubed along a steel bar, as shown in the front of the illustration, and inserted into furnaces, ovens, retorts, flues, gas mains, steam pipes, etc., to find the temperature at which they are operating. The salts that melt down and those that remain solid will indicate the temperature, which should be between the two. By using a long bar one can determine whether the temperature is uniform in the front and back, top and bottom, or corners, of a furnace, oven, kiln, etc.

This is said to be the only method that will give the exact temperature of tools heated in a forge fire. A paste is selected that represents the correct hardening temperature for the tool. It is daubed on the tool and when it is heated to this temperature the salt will melt and the tool can be taken out of the fire and quenched. It will make it easier if the tool is surrounded by a piece of sheet steel or is inserted in a gas pipe, as that keeps the paste from coming in contact with the fuel.

Another handy way of using the "Sentinel" cylinders is to plug one end of a tube or pipe and drop in a cylinder. A small rod can then be lowered into the tube and made to rest on the salt. When the salt melts down the rod will lower and thus indicate that the melting temperature of the salt has been reached. This is useful for finding the temperatures of molten metals, salt bath furnaces, etc.

The Selling Side

The Advance Car Mover Co. has been incorporated, with $30,000 capital stock and headquarters at Appleton, Wis.

J. B. Berry and S. S. Roberts have announced the dissolution of the firm of Berry, Howard & Roberts and the continuance of business, in the general practice of civil engineering, under the firm name of Berry & Roberts. Their offices are 1640-42 Transportation building, Chicago.

The Jones & Laughlin Steel Co. has purchased from the city of Pittsburgh, Pa., one and seven-tenths acres, formerly the property of the Monongahela Water Co., for $73,961, for future extensions.

The Chaloner Safety Stop Device & Automatic Switch Co. has been incorporated, with $300,000 capital stock, at Jersey City, N. J.

T. A. Willson & Co., Reading, Pa., were awarded the grand prize at the second international exposition of safety and sanitation at Grand Central Palace, New York, on December 12 to 19, 1914. This award was on the merits of the Willson safety glass, the Willson goggle and the Albex eye protector.

Henry Vogt Machine Co.'s plant at Louisville, Ky., has suffered a damage by fire of about $50,000.

The National Brass Co., Houston, Tex., has been incorporated with the following officers: President G. F. Cotter; vice-president, J. W. Cain, and secretary, F. H. Littrell. The company will specialize in the manufacture of car and locomotive bearings, as well as general railway castings.

The Universal Safety Brake Co. has been incorporated with $25,000 capital stock by R. and L. M. Bernfeld, S. Wiesenberg, 341 Crimmins avenue, New York.

The Remy Electric Co., Anderson, Ind., has purchased a plot of land in Detroit, upon which it will erect a plant. It will employ 1,500 men when operations are running full. The reason for the move is to bring the works nearer the company's center of trade. The concern is capitalized at $1,500,000, and has an annual payroll of $1,750,000. It manufactures magnetos, engines and electrical devices.

The Pratt & Whitney Co., Hartford, Conn., tool and machinery manufacturer, has bought the plant of the Pope Mfg. Co. for $300,000. The plant is being put in shape for manufacturing operations and B. W. Hanson, works manager of the Pratt & Whitney Co., is superintending the installation of the machinery. Most of the buildings purchased are to be occupied immediately by Pratt & Whitney workmen, except such space as will be required for the storage of the old equipment in the plant until this is sold by the receiver, Col. Pope.

E. H. Hinkens, superintendent of the Baltimore & Ohio reclamation plant at Zanesville, Ohio, has entered the sales department of the Ingersoll-Rand Company and will be located at the Philadelphia office.

Harry C. Quest has been appointed general manager of the railway department of the Nubian Paint & Varnish Co., Chicago.

C. B. Yardley, Jr., has been appointed representative of Wm. C. Robinson & Son Co., Baltimore, Md., manufacturers of high grade lubricating oils and greases. Mr. Yardley will make his headquarters at the New York office.

The Henry Giessel Co., of Chicago, has appointed Frank N. Grigg, 1201 Virginia Railway & Power Building, Richmond, Va., as its southeastern sales agent, representing them in all territory south of the Ohio River and east of the Mississippi River.

H. W. Cope has been appointed director of the exhibit of the Westinghouse Electric & Mfg. Co. at the Panama-Pacific International exposition and is now located in San Francisco giving his personal attention to the work.

The shafting works at the Mahoning valley plant of the Republic Iron & Steel Co., Youngstown, idle for several months, started operations Jan. 4.

Federal Judge Baker in the United States Circuit Court of Appeals has made a decision giving the Railroad Supply Company the right to exclusive manufacture of railroad tie plates. Suits against several steel companies were started by the supply company in 1908, charging them with infringing on the patents which were issued in 1895. The United States District Courts in Cleveland and Chicago gave verdicts adverse to the supply company and the matter was appealed. "It is one of the most important decisions in patent cases ever made," said H. S. Hawley, president of the Railroad Supply Company. "It involved the basic patents on tie plates, and several million dollars was involved. For six years the case has dragged through the courts and some of the ablest lawyers of the country have acted as counsel."

The American Brake Shoe & Foundry Co. reports for the year ended Sept. 30, 1914, net income of $1,023,572, a decline of $256,015 from the total for 1913. Preferred stockholders received the usual 8 per cent dividends, and common stock owners were paid 7 per cent. The surplus account was increased by the addition of $301,572 from earnings. The annual report says that the reduction of revenue was accounted for by the indifferent buying of equipment by the railroads. A factor which worked to offset this decline was larger income from investments.

Fred N. Baylies has been appointed eastern manager of the P. & M. Co., with offices at 30 Church street, New York, effective January 1, 1915. Mr. Baylies was formerly assistant sales manager of the Aluminum Co. of America, with office in Chicago, but has been a director of the P. & M. Co. since its incorporation.

Due to the death of the late Quimby N. Evans, the copartnership heretofore existing between Q. N. Evans, J. A. Almirall and W. C. Adams has been dissolved and the corporation of Almirall & Co., Inc., has succeeded to that business. The company's offices are at 1 Dominick street, New York, N. Y.

The H. W. Johns-Manville Co. has been awarded construction of cold storage box and installation of refrigerating machinery in the Municipal Lodging house at New York.

The Jones Safety Train Control System Co. has changed its name to The American Train Control Co., with offices at Baltimore, Md. This system is in use on the Maryland & Pennsylvania.

Arthur E. Jackman has been appointed manager of the machinery department of the Walter A. Zelnicker Supply Company, St. Louis, Mo., succeeding J. J. Hilpirt.

The foundry of the Climax Locomotive Works at Corry, Pa., was damaged by fire to the extent of $25,000 recently.

The Mesta Machine Company, Pittsburgh, Pa., has acquired the rights from the Stumpf Una-Flow Engine Company, Syracuse, N. Y., to build this engine in the United States.

E. B. Leigh, president of the Chicago Railway Equipment Company, has had a reprint, in folder form, of his article, that appeared in an October issue of "Iron Age," on "Railway Rate Regulation and National Prosperity." All manufacturers and railway supply men should read this able exposition of a most vital subject.

OBITUARY.

Archibald W. Inglis, formerly purchasing agent of the American Locomotive Company, died December 16 at his home in Paterson, N. J. He was 54 years of age.

Col. Edward D. Meier, former president of the American Society of Mechanical Engineers, died at his home in New York City recently at the age of 74 years.

Ernest A. Regestein, of the Standard Underground Cable Co., Pittsburgh, died at his home in that city on December 29.

Frederick K. Fitler, treasurer of the Somers, Fitler & Todd Co., Pittsburgh, machine tool and equipment dealers, died at his home in Atlantic City, N. J., December 31, after several weeks' illness.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

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CONTENTS.

An Opportune Appointment

In years past there has been a tendency to appoint politicians and lawyers as members of state railroad commissions and this condition still holds true to a considerable extent. However, there are indications that the members of these commissions are now being chosen from men who have an understanding of the questions upon which they will have to pass. One of the hopeful signs along this line is the recent appointment of Walter Alexander, district master mechanic of the Chicago, Milwaukee & St. Paul Railway as a member of the Railroad Commission of Wisconsin. Mr. Alexander, both by training and experience, is exceptionally well qualified for the position.

Among the state commissions, the Wisconsin Railroad Commission has shown fairness and good judgment in its decisions in the past, although it has sometimes been hampered by conditions over which it had no control. It will be remembered that some years ago this commission recommended a two and a half cent fare, but it was cut to two cents by act of the legislature. The law of the state requires that one member of the commission be a railroad man, and the appointment of a master mechanic of the state's principal railway is a fortunate and hopeful sign. It is to be hoped also that it pleases "Jim" DeVoy, for state and government regulation has been disturbing his peace of mind for some time now.

This appointment suggests a new field which the railway mechanical man may be called upon to enter, for it is quite probable that other states will follow the lead of Wisconsin. Public opinion with respect to railways is changing and the future may see many other appointments of railway men on commissions, where they can be depended as high minded men to act with fairness to all. No railway man is better fitted for such work than the mechanical official. He knows the practical working machinery of the road; he is with it every day. He has to be up on state and government regulations, together with legal matters; he has to appear at various hearings; he has to know about costs, tonnage rating and various other matters which are not strictly mechanical. There is an opportunity for the railway mechanical man to make himself of more value to his road and to the public.

Reclaiming Car Scrap

Economy is the watchword today of our railroads especially and of our country in general. It has a familiar sound to the railroad man, for he has been hearing it for some years now, but nevertheless it has lost none of its force and the ambitious railway official is keeping sharp watch to see where savings can be made.

Probably from the nature of its work, the locomotive and car department has been pressed harder in this respect than other departments, but it is certain that it is accomplishing a great deal along these lines. One of the points where much saving has been made is in the

handling of scrap material, a considerable portion of which comes from the car department.

The reclaiming of car scrap in connection with freight car repairs was made the subject of a paper recently delivered before the Western Railway Club and from the ensuing discussion it was clearly shown that the old practice of burning scrap cars is fast falling into disfavor. Although there are of course exceptions, the burning up of old cars is a waste of good lumber which it has been demonstrated can be used profitably on repair work and for kindling, should it not be available for other purposes. Furthermore, the burning of cars leaves a mass of twisted iron which is hard to straighten, and it is often damaged by the fire.

An instance of the saving in reclaiming car scrap was cited by an official of the Chicago, Burlington & Quincy, which has tried both burning and dismantling cars. Formerly in burning cars they were dumped into an old gravel pit and the cost of switching, crane work and reclaiming amounted to from $8 to $10 per car, and the scrap iron was in very bad shape. This road is now tearing the cars down in a discarded siding and the lumber saved more than pays for the cost of tearing them down. From seven hundred cars dismantled during the past year the road obtained $15,000 worth of lumber, at a cost of only $11,000 to $12,000. Another instance of saving was cited with regard to metal roofs. The Louisville & Nashville removes all metal roofs from cars to be destroyed and turns up the flanges, thereby effecting a saving of from $175 to $200 a month. The Frisco was reported to be using some of its discarded cars for the erection of small buildings; the metal car roofs being cut up into squares and used for shingles.

In the paper previously referred to, the practice of piecing out old bolts of seven-eighths of an inch or over, by the welding process, was recommended, but there is some difference of opinion as to whether or not this is economical practice. The economy in this case is dependent upon the amount of work which has to be done on the bolt, such as turning new threads, forming a new head, etc.

The reclaiming of materials which at the outset it appears cannot be done economically, ofter results in unexpected savings and it is well worth a few dollars to give all ideas with regard to methods of saving a trial. Sometimes, of course, it is discovered that it costs more to reclaim a certain part than to buy a new one. For instance, a road tried to build up a wheel-fit on some small axles and found that the built-up axles cost $22.44 as against $9.18 for new axles. It is very essential in work of this nature that a very careful study be made of the factors which should be included in the cost.

The reclaiming of car scrap is a subject which each shop or repair point on a road must study from its own particular viewpoint. The place to use scrap most economically is at the point where it is made, for if it can be used for repairing cars at the same place it is obtained, the additional handling and transfer charge against it is eliminated. Also, wherever scrap car material is reclaimed, the man in charge of the work must be one who can be depended on to give constant and careful attention to all the material handled, for this is the basis of handling scrap with economy.

Leaving Something for Discussion

A lively and enthusiastic discussion of papers presented before railway clubs is sometimes found to be a difficult thing to get started. In general this is not because the papers are uninteresting and do not cover the subject; in fact, perhaps the contrary is true. Most of the papers are good and show a considerable amount of work on the part of those who write them. Sometimes advance copies of the papers are not sent out by the secretary in sufficient time for the members to look them over before coming to the meeting. This is, of course, a great drawback to an enthusiastic discussion. There are always plenty of members who are qualified to discuss any particular subject; the difficulty is to get them started! Often a presiding officer will call on a number of members before getting one who will say something and then like as not the member will say that he can add nothing, as the speaker has covered the subject so thoroughly. A presiding officer can do a great deal to enliven discussion, but he cannot force members to talk. The paper itself must furnish the stimulus for the discussion.

However, papers which present a general view of a subject from all sides do not provoke as much discussion as does a paper which presents a one-sided view. The paper which considers the subject from all angles does not leave as much room for discussion, because it touches the viewpoints of practically all present. But if the writer of a paper to be given before a railway club wants to start something, let him incorporate in his paper a very decided view on the subject in hand. Let him give a positive opinion on every point and state that this is the only viewpoint which can be taken of the matter. Such a paper will not lack for discussion, for immediately when a positive statement is made it will arouse a combative spirit and everyone will take a turn at the speaker. It may not be pleasant for the speaker, but it will be beneficial for the society as a whole.

Of course, it is not contended that the writer of papers make absurd claims or statements, but rather that they present all the strongest facts and arguments in support of one view of the question, which will give the members a chance to bring out their arguments in support of other ideas and thus provide room for discussion. This need not detract from the value of the paper, which would then cover one idea thoroughly. The man who prepares a paper gets a great deal of good from it, but he should try to share the benefits with the other members, for the problem with most of our clubs today is to keep a lively interest among its members. The next time you have to prepare a paper, leave something for the rest to do.

Twenty Years Ago This Month

An account was published of an experiment being tried in Italy in jacketing the cylinders of locomotives with hot gases taken from the smoke box. It was reported that the system had effected a considerable saving.

A lap joint without any welt strip whatever was used by the Brooks Locomotive Works on many boilers built by it.

A paper on "Responsibility of Car Owners for Defects in Freight Cars" was presented before the New England Railroad Club. The discussion was opened by Mr. Madden, who advocated the new interchange plan and stated that there were four reasons why a change should be made in the M. C. B. rules, making car owners responsible for all defects except as provided for. The reasons were: First, that in inspecting for protection road had to employ a larger number of inspectors than were required in inspection for safety only; second, in order to make an inspection for protection, serious detentions of trains resulted; third, that a still further expense under the rules was incurred in the switching mileage, consequent on the setting out and returning of cars for repairs; fourth, there was an expense incurred in telegraphing for delayed freight. Others who took part in the discussion were J. T. Chamberlain, Mr. Rhodes of the C., B. & Q., Mr. Lents of the Lehigh Valley, Mr. Waitt of the Lake Shore, P. H. Peck of the Chicago Belt Line, and George West of the New York, Ontario & Western.

H. M. Perry resigned from the car department of the Cincinnati Southern to become manager of the Madison Car Works, Madison, Ill.

A circular was issued to the Master Car Builders' Association by its committee on "Interchange of Cars." The circular was signed by the following: Pulaski Leeds (chairman), J. W. Marden, L. Packard, J. N. Barr, E. D. Nelson, Samuel Irwin and J. H. Rankin.

L. P. Pomeroy read a paper before the New York Railroad Club on "Steel Axles."

E. E. Davis was appointed assistant superintendent of motive power of the Philadelphia & Reading.

The name of the Baltimore & Eastern was changed to the Baltimore, Chesapeake & Atlantic.

J. F. Graham was appointed master mechanic of the Oregon Railway & Navigation Co., vice E. B. Gibbs.

A correspondent expressed his disappointment that the majority of railroad officials who attended the annual conventions of the Master Car Builders and Master Mechanics' Association paid but little attention to the exhibits. This situation has improved during recent years, but some improvement could still be made.

An outline of the proposed laboratory tests of locomotives by the committee of the Master Mechanics' Association has been published.

B. Haskell, superintendent of motive power of the Chicago & West Michigan and the Detroit, Lansing & Northern, reported that he was using burlap for packing engine and tender truck boxes, the material being cut up fine preparatory to use. He found it equally as good as woolen waste with the additional advantage of costing nothing.

John N. Reynolds severed his connection with the National Car & Locomotive Builder to become western representative of the Railroad Gazette, with office in The Rookery, Chicago.

A paper on the strength of the railway car axles was presented by L. S. Randolph before the American Society of Mechanical Engineers. A series of experiments was greatly needed, according to the writer.

PACKING EQUIPMENT STANDARDS.

By A. E. M.

It has occurred to the writer that railroads could save quite a bit of money, and get better results with their metallic packing, any and all makes considered, if they would make all their vibrating cups in one shop. Very few roads do this at the present time, but the fact remains that the cups could be made more uniform and a great deal cheaper if the above recommended practice were carried out. The objection the mechanical department officials usually have is that cups usually are bored to fit the rods. Granted, but why not leave that part of the cups small, so when a new cup is required simply draw one from the storehouse, bore out the cup to fit the rod and the job is done. I venture to say that vibrating cups made in quantities with the proper tools and devices can be made for one-half of what, for instance, a small roundhouse shop could make them for; also, and here is the main reason for having cups made in one shop, the cups will all be alike over the entire system. The writer has seen about 57 different varieties of the same type of cups on one road; some made without even a template. The packing if it happens to be made by a manufacturer is all made the same. How could it possibly fit more than one kind of a cup. This vibrating cup proposition is certainly one proposition where even a poor system and standard is better than none. Of course, it should be patent to anyone that some real standard should be adopted for each kind of packing used, and all the cups made to that standard. Fixed reamers should be used and these kept to a standard by a master cup, or some other good method to insure uniformity. It would probably surprise the mechanical department officials after a few months to note that a great deal less packing was being used and the packing that was used was really packing the way it should. This proposition if carried out the right way will surely save money and get results. The writer would be very glad to do what he can consistently in the way of suggestions. Don't wait for summer, do it now.

CORRESPONDENCE

Editor *Railway Master Mechanic:*

The draft gear problem is certainly the most important item in considering railway freight. The annual cost of repairs to cars that are damaged through the draft gear failure, and loss and damage claims resulting from this cause far exceed all other repairs made to freight car equipment. The draft gear equipment on most of the old cars used in service today is inadequate to withstand the shock incident to the heavy power that is being universally used and there is only one thing to do and that is—do away with the old and put on the new, up-to-date modern equipment. Draft gear today is manufactured tandem, spring, and friction, and any of these is away ahead of even the most modern car construction. Short draft gear is used today on railroads on say seven out of ten cars and it appears that the only reasonable way would be to make as few repairs on these cars as possible and to retire them from service as speedily as economics conditions permit. Macgregor.

Editor *Railway Master Mechanic:*

I have read with great interest the article of J. D. MacAlpine in the December issue on "A Shop Accounting Association." Such an association would be the greatest step yet towards efficiency, although many roads have splendid systems of accounting. I believe there is a great deal of room for improvement, and these im-

provements cannot be made unless ideas of others are submitted. One feature it would bring out, which has been an enormous problem for a number of years, would be the elimination of fifty per cent of the correspondence. Methods could be arranged whereby those in charge of different departments could facilitate the labors of those under his supervision. The list of the subjects submitted by Mr. MacAlpine cover quite a large field, but the point to get at is to eliminate the intricate forms. Simplicity, in my opinion, is the greatest feature of efficiency.

It is a well-known fact that there are at present a large number of mechanics who are proficient in the class of work to which they are allotted, but are unable to understand some of the various forms put before them, and oftentimes misconstrue the purpose for which they are made. Correspondence is virtually so much "red tape" to such men, but let them understand a standard form and the information obtained is invariably correct. I will certainly be glad to hear of Mr. MacAlpine's proposition being pushed along and would like to hear further along the same lines. EDWARD E. KIEFER,
Chief Clerk to M. M., Colorado & Southern Ry., Trinidad, Colo.

INTERNATIONAL ENGINEERING CONGRESS

The technical success of the International Engineering Congress is now well assured. Notwithstanding the difficulties arising as a result of the present European war, the committee on papers is able to count on from 200 to 250 papers and reports covering all phases of engineering work and contributed by authors representing some 18 different countries. The Congress will therefore be truly international in scope and character, although the representation from the countries involved in the European war will naturally be less than originally planned.

The papers are now rapidly coming in and their character gives the fullest assurance that the proceedings will form a most important collection of engineering data and a broad and detailed review of the progress of engineering during the past decade.

The committee of management is now issuing to all important engineering societies, in this country and abroad, invitations to appoint official delegates to attend the sessions of the Congress, and the presence of a considerable body of such delegates is well assured. The Congress will be held at San Francisco, Cal., on September 20-25,

WHAT IS THE MATTER WITH THE UNITED STATES?

By Herbert N. Casson.

As I have been residing in London since the beginning of the war, I have been hearing the question asked on all sides. I have never heard any satisfactory answer. No one seems to know.

Why are the American factories not running night and day? Why are the railroads not opening up new territories and getting ready for the millions of immigrants who have already made up their minds to leave Europe as soon as the war is over?

Why are there not fifty American drummers in London right now trying to sell $200,000,000 worth of American goods in place of the goods that were bought last year from Germany and Austria?

Why have advertisers become quitters, just at the time when their advertisements were most needed and most effective in cheering on the business forces of the United States?

From the European point of view, the United States is a haven of peace and security and prosperity. It has no troubles that it dares to mention to Belgium or Austria or France or Germany or Servia or Great Britain or Russia.

Every tenth Briton has enlisted. Every tenth Frenchman is at the front. Every tenth Belgian is dead. What does the United States know about trouble?

If I could afford it, I would charter the "Mauretania" and "Lusitania" and convey a party of 5,000 American advertisers to Europe for a trip of education. I would give them a week in London, a week in Paris and a week in Antwerp.

I would let them look at the United States from the scene of war. I would give them a look at real trouble. I would let them see trains, ten at a time, five minutes apart, packed with the maimed and dying.

I would let them hear, from fragmentary survivors, the incredible story of battlefields 150 miles wide and armies that are greater than the entire population of Texas.

I would let them see graves 100 yards long and full and Belgium, the country that was, nothing now but 12,000 square miles of wreckage.

Then, when they began to understand, to some slight extent, the magnitude and awfulness of this war, I would say to them:

"Now go back and appreciate the United States, realize your opportunities. Don't start digging trenches when nobody is firing at you. Don't fall down when you have not been hit. Don't be blind to the most glorious chance you have ever had in your life.

"Go back and advertise. Get ready for the most tremendous boom that any nation ever had. Build your factories bigger. Train more salesmen. Borrow more money. Go ahead and thank God you are alive and that your family is alive, and that you are living in a land that is at peace, at a time when nearly the whole world is at war."

RAILWAY INCOME AND REVENUE

Railway operating income for November, reduced to a per mile of line basis and compared with that for November, 1913, shows a decrease of $42, or 14.7 per cent, while operating income per mile for November, 1913, was 21.2 per cent less than for November, 1912. Total operating revenues per mile for November decreased 13.3 per cent, as compared with November, 1913, operating expenses per mile decreased 13.3 per cent, and net operating revenue per mile decreased 13.4 per cent.

Figures prepared by the bureau of railway economics applicable to railways operating 228,461 miles of line, or about 90 per cent of all steam railway mileage in the United States, show that the operating revenue of these roads for the month of November, 1914, amounted to $233,812,430. This amount includes revenue from freight and passenger traffic, from carrying mail and express, and from miscellaneous sources connected with rail and auxiliary operations. Compared with November, 1913, these operating revenues show a decrease of $32,836,569. Total operating revenues per mile averaged $1,023 in November, 1914, and $1,180 in November, 1913, a decrease of $157, or 13.3 per cent.

Reduction in Accidents, C. & N. W. Ry.

The following statement shows the reduction in number of accidents on the Chicago & North Western for four and one-half years ending December 31, 1914, as compared with four and one-half years on same basis as year ending June 30, 1910, before the Safety First committees were organized:

173 fewer employes killed, a decrease of 35.3 per cent.
10,671 fewer employes injured, a decrease of 27.3%.

New Shops of the Chicago & Alton R. R.

The Shops Recently Completed at Bloomington Contain Some Innovations in Connection With the Locomotive and Blacksmith Departments

There has lately been completed for the Chicago & Alton Railroad at Bloomington, Ill., new shops which in some respects are an innovation; the placing in one building of the several departments of the locomotive shop and the layout of the blacksmith shop being quite different from what has been the usual practice.

GENERAL.

The Chicago & Alton has had locomotive and car repair shops, together with an engine terminal in Bloomington for a great many years, and when the necessity for increased capacity, as well as new and modern shops, came up sometime ago, considered the advisability of removing these facilities from Bloomington altogether. This, the city of Bloomington objected to, and to show the sincerity of their objection offered to provide such land as was necessary, not only for the actual present needs for the enlargement of the railroad facilities, but also to provide enough land to take care of future requirements for some time to come. The city and the railroad company finally came to an agreement by which the city provided the land necessary for the enlargement of the company's shop and yard facilities, and the railroad agreed to build on that location.

The new group of buildings which have just been completed are located on that tract of land which is northerly of the location of the old shops and yards, the city being obliged to close several streets in order that the land should be in one tract.

The general layout of the new plant comprehends provision not only for existing and probable future needs, but the utilization as far as possible of the old shops and the relation of the whole to the development of a well defined scheme that will ultimately use the tract in the most economical and effective manner.

As will be noted from the accompanying plan the new layout comprises a centrally located locomotive shop building, an L shaped blacksmith shop, located south of the locomotive shop, a two-story storehouse with large storage platform situated east of the locomotive shop, and tire heating and flue rattler building.

Erecting Bay, Locomotive Repair Shops of the Chicago & Alton R. R.

Between the buildings are located yards for storage of material together with the necessary tracks and platforms for the requisite handling and trucking.

LOCOMOTIVE REPAIR SHOP.

The locomotive repair shop is a building 619 ft. in length by 317 ft. in width covering an area of nearly 4½ acres. Inside of this building are the erecting shop, machine shop and boiler and tender shop; the different departments having track connection with the various yard tracks and with the storage yards. The building is divided into five longitudinal bays, the central bay being 75 ft. wide and the four side bays each 60 ft. wide. In the central bay is located the erecting shop and in the side bays are the machine departments, the boiler shop, the tank shop and the master mechanic's and foreman's offices, together with tool rooms and sub-storerooms.

General View of New Locomotive Repair Shops of the Chicago & Alton.

This building has a structural steel frame resting on concrete foundations with side walls of concrete carried up to the window sills. Above the sills the building is of brick with the exception of the high walls of the erecting bay, which are of tile with stucco finish. The roof has wood purlins with 2 in. plank covered with prepared roofing. The floor in this building and in the tin shop consists of a 4 in. sub-base of tarred rock well rolled, covered with a 1 in. layer of sand and tar, in which is embedded an under flooring of 3 in. yellow pine overlaid with a 1-1/16 in. maple floor. The building is exceptionally well lighted; the large window area of the side walls and the sawtooth and monitor construction in the roof giving over 28% of the floor space of lighting area.

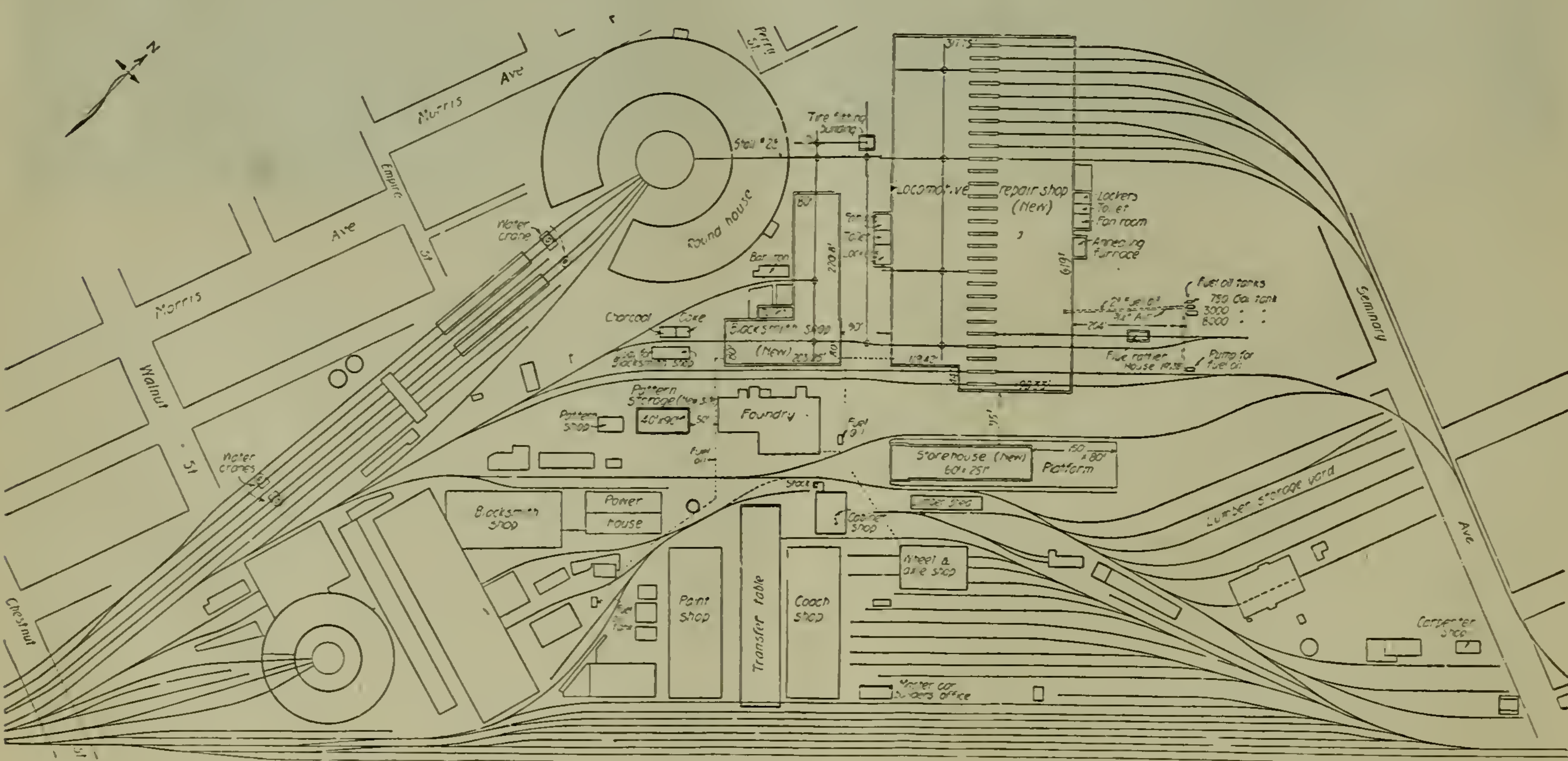
The co-ordination of the various departments under one roof without partitions is an innovation in railroad shop layout, and admits of such an arrangement of tools that work and materials may pass through the shop in an orderly and progressive manner with the least possible rehandling.

The erecting bay is 75 ft. wide on column centers with 28 pits. It is served by two traveling electric cranes on two levels, the crane for the unwheeling of locomotives being of 150 tons capacity, equipped with two trolleys of 75 tons capacity, located on the upper runway, while the lower runway carries a ten ton messenger crane. On every alternate column between the erecting pits jib cranes are provided for handling materials on the front ends of the locomotives.

Adjoining the erecting bay to the south is a 60 ft. bay in which are located the heavy machine tools, served by a ten ton traveling crane. Still further south is another 60 ft. bay, in which are placed the lighter tools. The heavy tools are all equipped with individual motor drives, while the lighter ones are arranged in groups driven by motors of 20 to 25 horse power.

On the north of the erecting bays are two 60 ft. bays for the boiler and tank work. These two bays are served by traveling cranes, one of 15 tons capacity and the other in the boiler assembling bay, of 40 tons capacity, equipped with two trolleys.

The hydraulic riveter is centrally located in the boiler shop with tower constructed especially for it, and is served by its own 25 ton crane.



General Layout of Chicago & Alton Shops at Bloomington.

Castings Platform, Bloomington Shops.

HEATING.

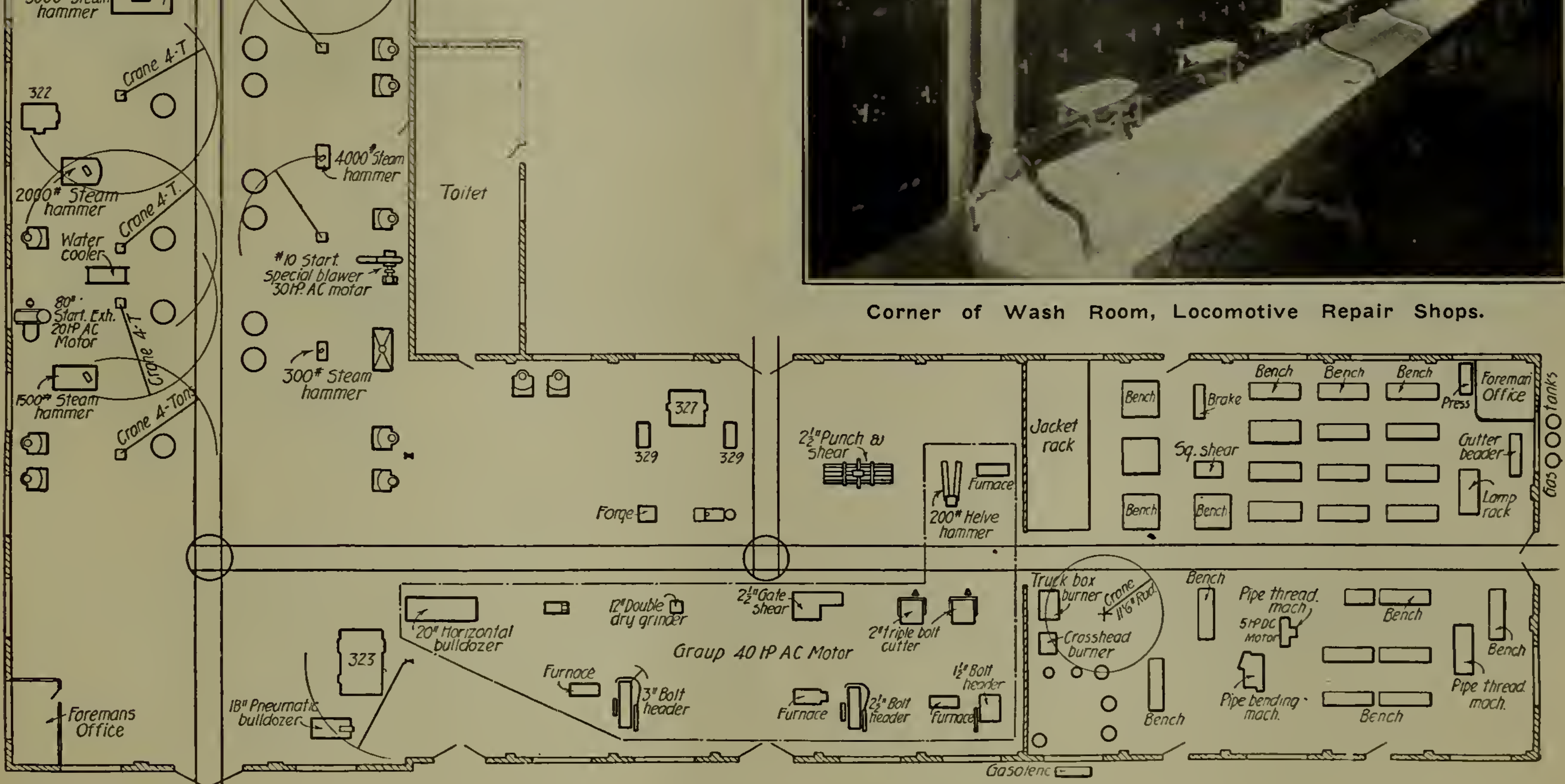
The shop is heated by an indirect blower system located in two specially constructed rooms built outside of and immediately connected with the main walls of the shop, and situated one on either side of the building about midway of its length. The rooms are large enough so that they are divided, a part of the space being used for lavatory and locker rooms for the men. The blower system consists of two 240" steel plate exhauster type fans direct connected to horizontal throttling engines. These fans draw air through 20,200 sq. ft. vento heaters and discharge it through concrete underground ducts to register boxes located along the outside walls and on interior columns.

The vento heaters are supplied by high pressure steam transmitted from the power house about 1,000 ft. away, at 125 lbs. pressure, which is reduced in the fan room to 1½ lbs. The exhaust steam from the fan engines is also used in the heaters.

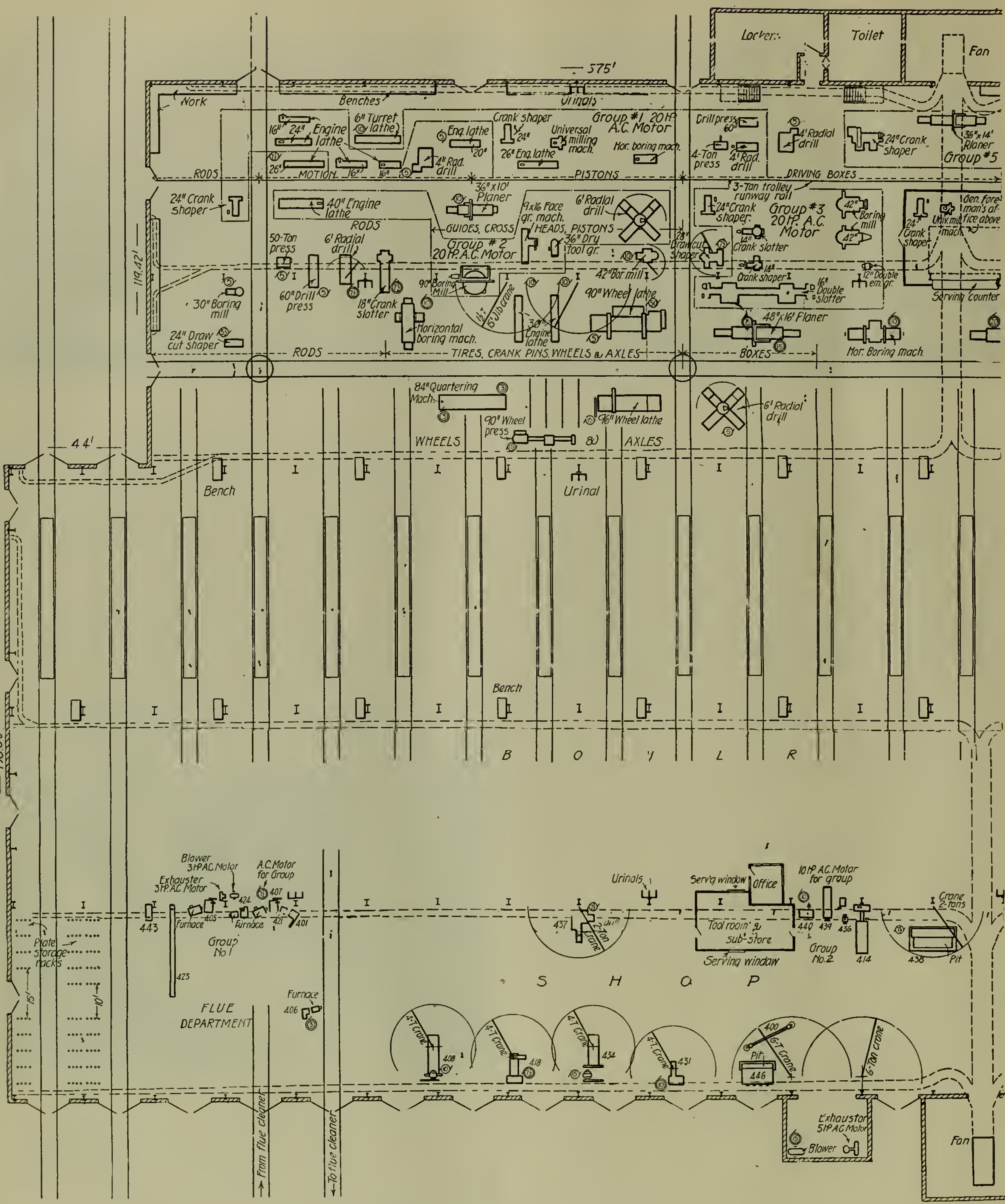
LIGHTING AND PIPING.

The artificial lighting is done by Tungsten nitrogen filled lamps in 400 watt units, the lamps being so spaced that there are no shadows and no necessity for individual lamps on the machines, except for inside work.

Corner of Wash Room, Locomotive Repair Shops.



Tool Layout of the Blacksmith Shop.

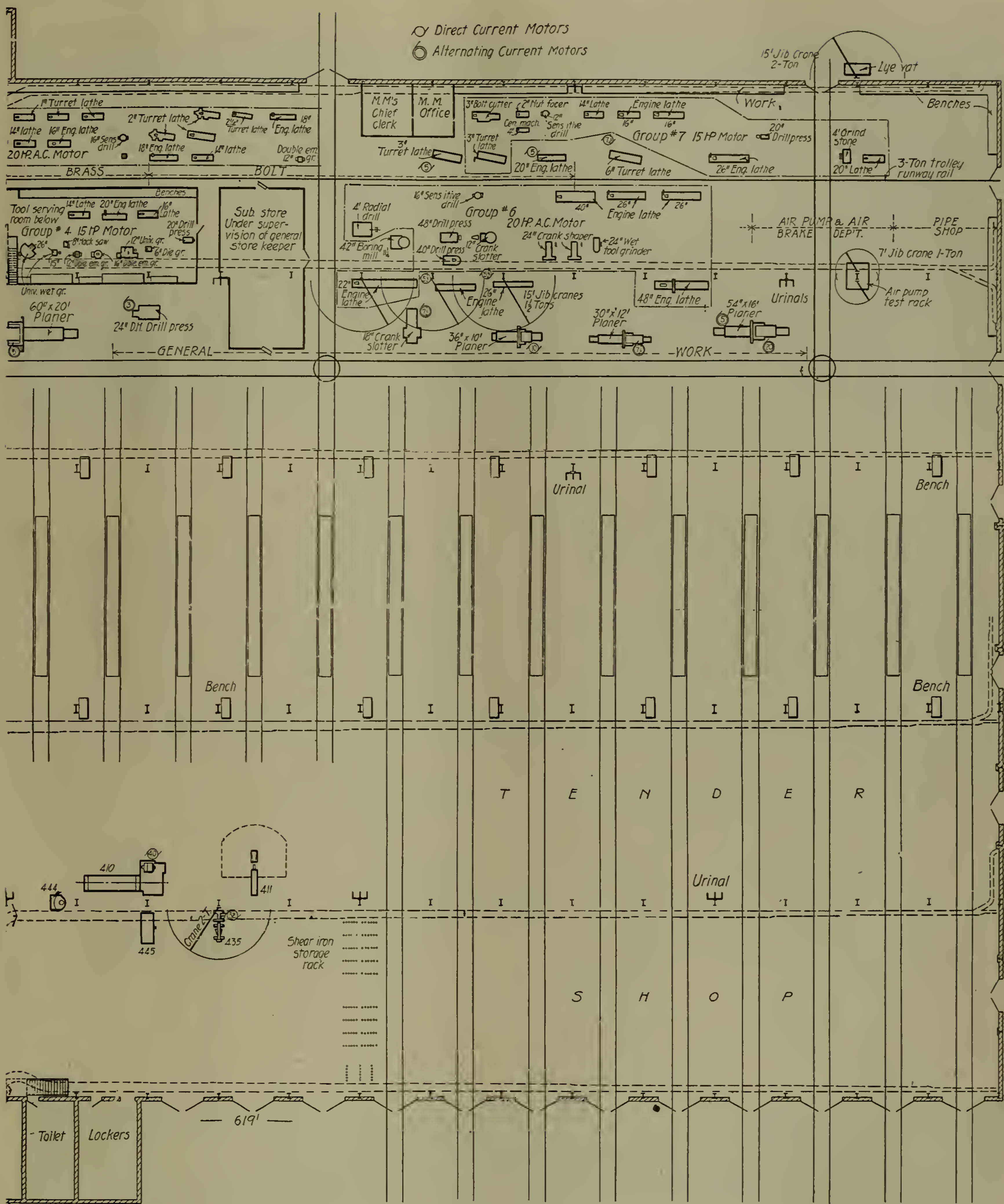


Tool Layout of Machine and Erecting Shop.

A suitable system of piping is provided for distributing live steam, compressed air, fuel oil and also water for fire protection, drinking and hydraulic pressure.

BLACKSMITH SHOP.

The blacksmith shop is of brick and steel construction on concrete foundation, similar to that of the locomotive shop. It is an L shaped building 80 ft. in width, one wing being 200 ft. and the other 300 ft. in length. In the 200 ft. wing are assembled all the steam hammers ranging from 300 lbs. to 6,000 lbs. and in the 300 ft. wing all the forges and small power tools. A space 100 ft. in length has been partitioned off in this wing to be used as a tin shop. This is a temporary expedient, it being the intention ultimately to remove this department to other buildings when the needs are such as to require this space for blacksmith work.



Tool Layout of Machine and Erecting Shop.

The roof trusses on the 200 ft. wing are 10 ft. higher than those in the other wing, due to the 30 ft. headroom required to accommodate the jib cranes and hammers.

A lavatory is located in the angle of the L in an addition just outside the main building, which provides toilet and washroom facilities for the men. The excellent ventilation given by the monitors in the roof and the means provided for removal of smoke and gases from the forges makes it an ideal shop in which to work.

In the general design special care was taken to provide a layout that would afford opportunity for an orderly progression of the work through the shop and ease and economy in transporting materials or parts to the point of final use in the locomotive shop, with which it has suitable track connection.

STOREHOUSE.

East of the locomotive shop and separated from it by a 95 ft. storage yard is located the storehouse, a two-

Interior of Machine and Erecting Shop.

story brick building with wood roof 60 ft. wide by 250 ft. long. The building is constructed without basement, the first floor being on an earth fill and affords facilities for handling and storing heavy materials on a level with car floors.

A wooden platform on concrete piers 10 ft. in width extends the entire length of this building on both sides, while a large storage platform 80 ft. by 150 ft. with floor laid on an earth fill is provided at the north end.

Ample storage bins, carefully arranged in transverse rows to give a maximum of light in the aisles, have been provided. The first floor and platforms, being on a level with the car floors, reduce the cost of handling heavy stock to a minimum.

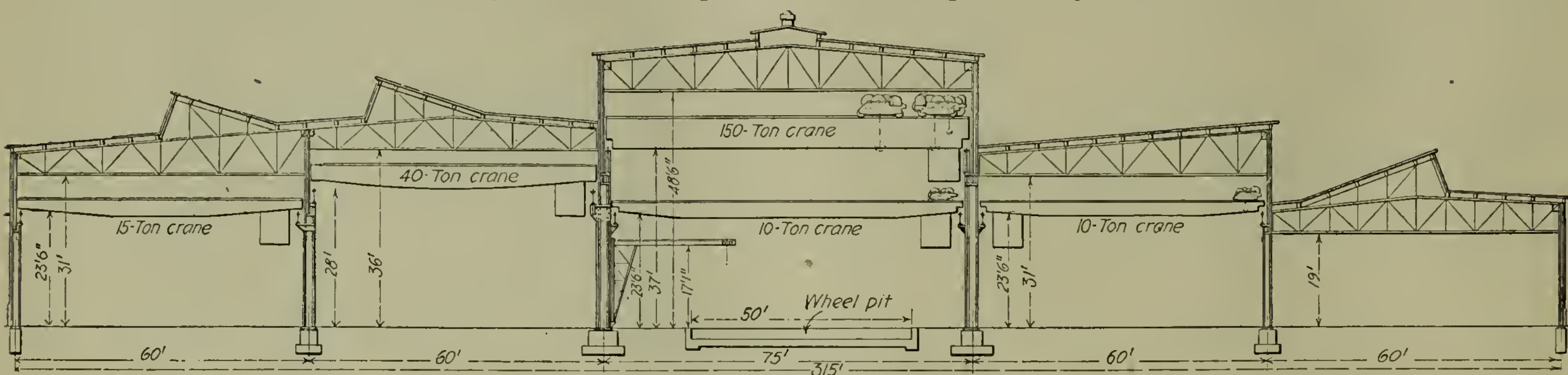
The second floor, where the lighter materials are stored, is served by an electric freight elevator of 5,000 lbs. capacity, while a chute is provided by which small packages, made up on requisitions, can be transferred to the first floor for delivery.

At one end of the building ample well lighted office space has been provided for the general storekeeper and his clerks, together with adequate toilet facilities, and also a room has been fitted up as a first aid hospital.

The plan of the yard layout shows the very convenient relationship of the various buildings to storehouse and to each other, and to the roundhouse and the very complete arrangement of tracks serving them.

To permit of the erection of the storehouse and the laying of some of the tracks it was necessary to remove to new locations two rather old buildings built of stone masonry. These were of considerable size, one of them being two stories high, but they were successfully moved with their contents intact.

The shops and layouts were designed and constructed



Cross Section of Machine and Erecting Shop.

Interior of Blacksmith Shop.

by Westinghouse, Church, Kerr & Company of New York and Chicago, acting in co-operation with H. T. Douglas, Jr., chief engineer, and J. E. O'Hearne, superintendent of motive power of the Chicago & Alton. The actual field construction was in charge of P. J. Watson, assistant engineer of the road.

The Car Department Paint Shop*

Some Points Which Help to Make for Better Work in the Railway Paint Shop

By William Buchanan, Foreman Painter, D. L. & W. R. R.

An up-to-date shop, first of all, must be equipped with modern devices for handling the work with as much dispatch and safety as possible, for cars at all times are in demand regardless of the fact that the management want them painted.

There is no money expended in the maintenance of railway equipment that gives more value for its expenditure than a well protected car, be it of steel or wood construction. On the steel car, rust and corrosion soon take place, caused from the sulphur dripping, etc., destroying the lasting qualities of the parts attacked, and the car becomes weakened and is a source of danger in transit.

The Delaware, Lackawanna & Western considers it necessary to repaint its steel cars once in three or four years, covering all portions of the car, and as far as my observation has gone, the stenciling is always legible and most of the exterior of the car is in good condition. We maintain a system of painting them in series, so that no haphazard painting will be resorted to.

Our wooden cars give a longer term of service. However, those which contain steel underframes require closer check, and if we discover the frames are rusting, we scrape and paint the frames and steel roofs whenever conditions warrant it, assuming that an ounce of prevention is worth a pound of cure. The modern wooden car is more or less of steel construction and should receive as much attention as the all-steel car.

In most cases, no attention is given the underneath irons on cars, when in fact, of all parts, they should be protected, for a rusty air-line soon becomes weakened and inefficient.

This is also true regarding the steel underframes and in fact, all underneath parts. Next of importance is the modern steel or semi-steel roofing. It is very important that it should be kept in first-class condition in order to preserve it. The undersides as well as the outsides should be well painted when being constructed, for the most deadly enemy to steel is moisture and there is no place where it is more apt to lurk than in the hidden portions of car construction.

Next of importance is that of stenciling. One of the most expensive operations in painting cars is stenciling, and for that reason should be done with a desire to convey as prominently as possible what is required.

The name and number of the car should be in a fixed place, so that a habit can be formed to know at all times just where to look for the information wanted. I know of no class of railway employees who would appreciate this more than the inspector, whose duty calls him out at all hours of the day and night and in some of the most trying places.

The writer is most happy to say that at last a movement is under way to get the car owners to adopt a system of uniform standards of lettering, and I am sure if the time ever does come, everybody will rejoice, especially the men in charge of the painting.

Some roads have advanced the idea that painting of freight cars cannot be done during the winter months, especially in this climate and out of doors. During the year of 1907, when we started the work at our East Buffalo shops, we painted 1,413 cars; nine in January, three in February, two in March, being practically at a standstill for three months. During 1909 we painted 2,198 cars; 156 in January, 128 in February and 182 in March. The present year we will close with over 3,000 cars; 177 in January, 158 in February, 165 in March and 222 in April.

I am giving you these figures to show that we have all been wrong in assuming that work of this nature could not be done during the winter months. Not only did it cut down our year's total output, but we were obliged to lay off men who were more or less of value, due to the fact that in working together they become more efficient and can cover more work than new men can, when you again wish to reorganize your gang.

Inasmuch as most of the work done is in the open air, tracks should be assigned for this special purpose so as not to interfere with the repair men, and a perfect rotation should be built up in order to be able to agree on a stated output each day.

The weighing of cars is no small item to cope with, and for this reason should be entrusted to a reliable man who, after the cars are weighed, can replace the new weight, giving us a report of the old as well as the new weights so that we can make the proper reports of same. This is very essential, especially where some of the cars are being equipped with the new Economy draft gears, and also in weighing and billing for foreign cars weighed.

The men who are assigned to look after the repair yard must at all times be on the alert, for whenever cars are undergoing repairs, more or less of the sheathing is ripped off, thus destroying the stenciled information, which should be replaced before the car goes back into service.

One item is wrong door numbers, due to the fact that an old door of some other car has been used in lieu of a new one. This is a source of confusion to those who are obliged to take numbers, as often the number is taken from the door instead of the side of the car.

The reclaiming of paint skins and settlings is an item that should be thoroughly looked after, for considerable money can very soon find its way to the scrap pile if the stock man is not onto his job every minute. He is also responsible for tools and brushes given out each day to see that they are returned at the end of the day's work and placed where they belong.

A suitable building for the storage of oil and paints is very essential; also modern devices for mixing same. Also, suitable and sanitary quarters for the workmen is very necessary, for you will remember that our best generals claim that no great battles are ever won with unhealthy men behind the guns.

* A paper read before the Niagara Frontier Car Men's Association, December 16, 1914.

Revised Schedule of Demurrage Charges

On February 1 the American railroads put into effect a revised schedule of demurrage charges on refrigerator cars in which perishable freight is shipped.

The new schedule of demurrage charges on these classes of equipment allows shippers two days' free use of cars; following which there is a charge of $1.00 a day for the third, fourth and fifth days, and $3.00 a day for the sixth, seventh and eighth day that equipment is held. For the ninth day and for each additional day after that time the daily demurrage charge is $5.00.

The demurrage regulations governing the class of equipment which have been in effect have allowed two days' free use of the cars and a uniform charge of $1.00 for each additional day.

GENERAL NEWS.

The Canadian railway commission will be asked by Canadian railroads for permission to increase freight rates throughout the Dominion, if increases now being asked because of changes in United States railroad rates be granted.

Grand Trunk railroad officials announce their intention to ask 14,000 of the employes in Canada and the United States to accept a decrease in wages April 1, if traffic receipts continue to decrease.

Car Department Correspondence*

The Reduction in Unnecessary Correspondence and the Necessity for Brevity Are Important Points in Car Department Correspondence

By Charles Claudy, Chief Clerk to Gen. Car Fmn., Belt Ry. of Chicago.

Anyone intimately associated with the handling of correspondence and reports connected with the car department will agree that a considerable volume of the work could be eliminated if its origin were handled more thoroughly and accurately. While the degree of efficiency varies on different railroads according to the systems used and energy applied in educating those originating the correspondence or reports, yet we believe that the car departments on all railroads are confronted with problems of a similar character in a general way representing a large amount of wasted time and material, which we would be glad to find some means of overcoming, if possible. In discussing this subject it is not our purpose to enter into elaborate detail but to treat the subject more in a general way, trusting to bring out sufficient points to stimulate a thorough discussion of the subject by the members present.

We realize that if we had in our own department the highest possible degree of efficiency we would not yet have all the apparent unnecessary correspondence eliminated as we are confronted with the same element of trouble originating in other departments over which we have no control, but it is not the thought of this paper to introduce criticisms against other departments but to discuss our own shortcomings which are within our province to overcome, as far as possible, with the view of stimulating effort toward a more efficient service. The manner in which the records are made and correspondence handled in the car departments to a great extent affects the various other departments of the railroad; the effect being good or bad according to the degree of efficiency or inefficiency. The car department is called upon to furnish information affecting such subjects as loss and damage claims, personal injury, train accidents and responsibility for damage to equipment with a view of placing responsibility where it justly belongs, conserving resources against unjust responsibility and removing objectionable causes. If such information is not furnished fairly, accurately and thoroughly, it becomes at once a germ for unnecessary correspondence, efficiency is crippled and often defeats justice.

We have said, information should be furnished fairly, meaning by this that no effort be made to evade responsibility through unjustly deflecting the information in the direction of another department of your own railroad or to a foreign railroad. If the true facts are not reflected the real intent of all reports and records is defeated and opens up avenues for questions with its corresponding train of evils. No employe should be required or expected to establish records or reports not tempered with justice and a clear conscience, as honest service in every respect is the foundation upon which efficiency is constructed. The information should be accurately and thoroughly recorded, having in mind such detail as may be essential for giving thorough knowledge of the subject at such times as it may be required. Brevity is efficiency when not lacking in essentials, but necessary details should not be sacrificed for brevity. Some employes record important records with only sufficient details to reinforce their memory should they be required to use them, apparently forgetting that the records made today are often to be used by someone else tomorrow. Therefore, important records and reports should be so recorded that they will be clearly intelligent to anyone qualified to pass upon them and we believe that this fault is a fruitful source of unnecessary correspondence in the car department.

Unwarranted technicality or lack of the spirit of broadness and fairness in conducting correspondence with foreign railroads more especially is another source from which considerable unnecessary correspondence arises. It is perfectly proper in some instances to defend a principle, although the amount involved may be small, for if it is a correct principle it should be correctly established, as the same principle may involve larger questions in the future, but we often find ourselves vigorously defending with technical arguments questions where no actual principle is involved with over-confidence in our own opinion and lack of due appreciation of the other arguments advanced with the very frequent result that the labor and material waste is a deficit to your railroad.

Perhaps the largest individual source of what we term unnecessary correspondence is the result of errors made in reporting wrong car numbers and wrong initials. Through the increase of equipment necessarily requiring more figures in composing numbers has very much enlarged the opportunity for errors of this kind. While some of these errors are the result of office errors, they are largely due to errors made at the initial point of the transaction which was performed by the car inspector or repair track foreman. To eliminate these errors in their entirety seems impossible, as none is infallible, and when we consider the adverse conditions under which these records are often made, such as inclement weather and rush of business, we wonder if those who frequently criticise could do better or even so well, under similar circumstances, and we feel that any criticism of these errors should be tempered by first placing ourselves in the other fellow's position and then our spirit of criticism is most generally considerably modified. A wrong car number injected in a foreign bill for car repairs usually means a letter of exception from the mechanical department of the railroad billed to their auditing department, which in line is communicated to the auditing department of the road billing, then to the mechanical department billing, who must investigate through the car accountant and also the mechanical representative originating the information and when the error is corrected it must retrace its steps and after this routine has been completed the result obtained is the same as it would have been without this unnecessary labor and delay had the initial performance been free from error. A wrong initial carries with it even a greater detail of investigation to correct than the wrong car number. Practically the same detail is necessary in handling claims, accidents, etc., when wrong numbers and initials are reported.

To eliminate, as far as possible, such errors should be the aim of all car departments. Some roads resort to discipline in an effort to overcome these errors, but we do not look upon such methods with particular favor, as they are not wilful neglect of duty; but exercise every reasonable effort to overcome such errors through a keener knowledge of the effect such errors have, and if a suitable degree of efficiency cannot be established find a more fitting place in your organization for such material.

Another means of reducing correspondence and adding to the efficiency of the car department is promptness in handling reports and correspondence. All well regulated car departments have certain reports which are required and if these are furnished promptly and while the subject is fresh it will insure a clearer statement of facts, as well as avoid the too frequent necessity of being called upon to furnish them. The same is true in handling correspondence. If replies are made as promptly as possible the information furnished can be presented in better form, in less time and avoid the necessity of "urgers" being sent out which may require passing through a number of offices adding its share of work to each one as well as increasing the volume of correspondence to be examined.

A defective filing system adds its share to confusion and unnecessary labor. It is often found that the information sought is already a matter of record directly in our possession and through ineffective methods the connection is not made and we impose additional correspondence upon our own office as well as other offices through this defect.

While we have previously touched upon brevity we wish to mention it more specifically, but at the same time retain the thought that it should not be practiced to the extent of destroying efficiency. A brief and concise statement of facts either in reports or in correspondence is far more forceful than repetition and

*A paper delivered before the Car Foremen's Assn. of Chicago.

unnecessary details. It consumes less time of the party imparting the information as well as the recipient of same. In order to do this, sufficient thought should be given the subject under consideration to get a clear conception of it in the mind after which both brevity and detail can be rounded into a harmonious combination. Failure, in answering correspondence, to make proper reference to files, often results in confusion and delay which could be avoided if this feature was given due attention.

The reduction in unnecessary correspondence and the standard of efficiency is best accomplished through an efficient organization from the head of the department to the lowest in the ranks. Oftentimes men are employed to perform certain duties and perfection is expected when they are wholly unqualified through lack of training to perform such service. A perfect failure in the office might be a big success on the repair track and often the man performing manual labor has a keen mind for handling mental problems. The entire organization should be continually studied with the view of detecting certain dormant qualifications which could be readily developed into an effective service. When your machinery is properly assembled and the necessary lubrication applied in the way of conducting a suitable system of education among your employes defining their duties with clearness and precision, the power can be turned on without much fear of serious breakdowns.

In conclusion we wish to give a few quotations from Elbert Hubbard, in discussing the "efficient man," which we believe can be appropriately applied to each of us as individuals:

"The efficient man is he who sees the obvious, who does the duty nearest him—and does it well—and keeps on."

"The secret of efficiency is no secret. It is simply the possession of imagination to know the right and do it well."

"Unquestionably the first step towards efficiency is self-respect. A grounded wire is wasted energy; light and power come from contact."

"A man's efficiency is determined by the amount of supervision he requires."

FORGING STEEL TRANSOMS

By Paul H. Cain, C. C. C. & St. L. R. R., Beach Grove, Ind.

The illustrations show the operations of making a open hearth steel transom for Pullman or motor trucks on a forging machine. The bar size is 1½"x8", and in the first operation the bar is deflected 3" on a bulldozer. The bar ends are heated and put in a shearing die on the same machine, finishing the second operation as shown in figure 1. Figure 2 shows the transom end, the bar size being 1"x12", sheared to a length of 11", bent and hole punched, giving an angle 8"x2⅝"x12". These two operations are finished in one heat. Figure 3 is the transom bar and end prepared for forging machine dies. The bar being heated and the end being applied cold, it is then split with a chisel and riveted as shown at point A on figure 3. Figure 4 shows the stationary die and heading tool, a special heading tool holder being used. Figure 5 shows the stationary die, heading tool and transom end, while the machine stroke has gone its full length, one stroke of the machine welding and forming the transom end as shown in figure 6, the finished transom.

Precaution must be exercised in the amount of stock used in the bar to attain the desired fillet, as shown at point B and C, figure 6. In figure 2, the transom end, allowance should also be made for the amount of stock to attain the desired square corner, as shown at point E. Figure 7 shows the surface plate with blocks, with which the transom is squared at the same heat coming from the forging dies. Figure 9 shows the transom complete on surface plate, squared and forged to length. With the aid of the blocks and clamps, as shown in figure 7, the transom is squared accurately. Figure 8 shows a clamp which is applied to the transom bar at point F in figure 6, serving a connection for the use of a crane.

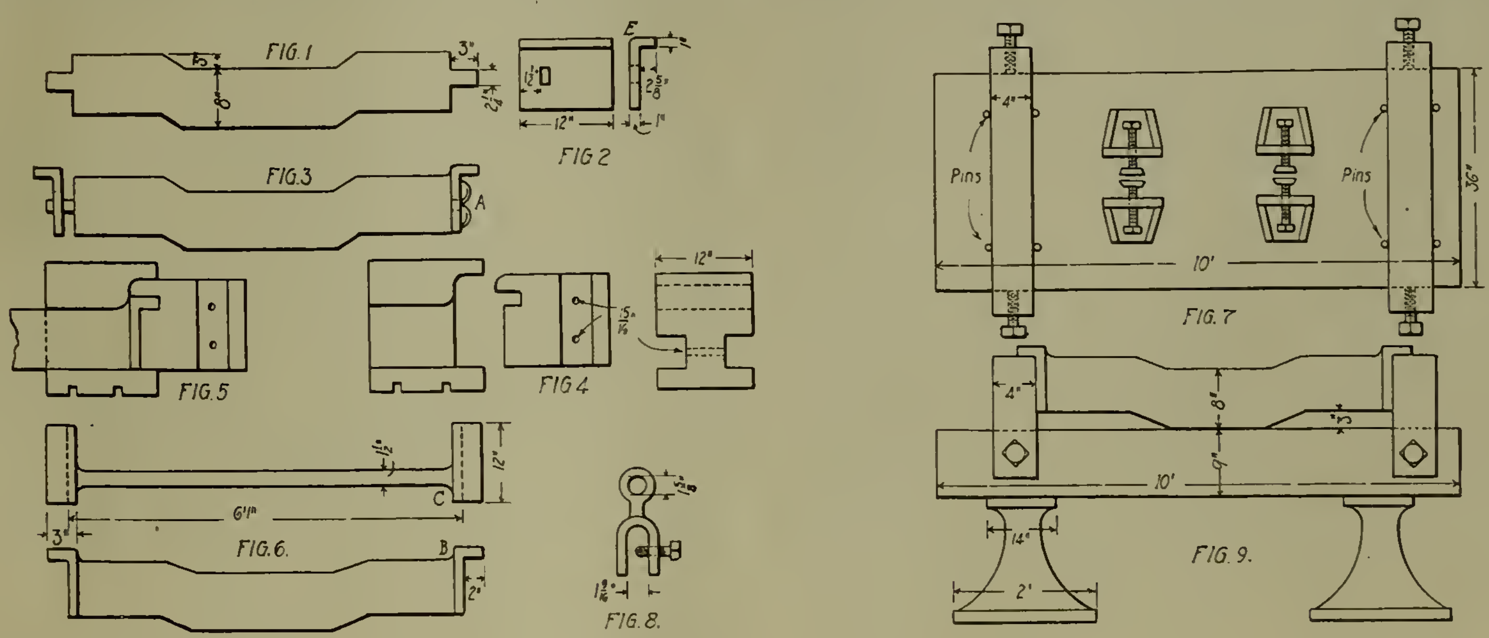
After the transom bar and ends have been prepared for the forging machine dies the production of this forging is one transom complete every 12 minutes. The tools used are one heating furnace, one welding furnace with two separate compartments, a forging machine and a special surface plate, as shown in figure 9. A forging machine operator and a fire helper are required. This forging has been tested both as to tensile and torsional strength and has proved entirely satisfactory.

A HIGH VOLTAGE ELECTRIFICATION

Another important indorsement of the high voltage, direct current system for railway electrification is the decision of the Ontario Hydro-Electric Power Company to employ 1,500 volts direct current for the electrification of the London & Port Stanley Railway. Orders have been placed for the initial rolling stock, including three 60-ton electric locomotives, five four-motor multiple unit cars, and four trail cars. This road is about twenty-four miles long and connects Port Stanley on Lake Erie with London, Ontario. The electrification of this steam road division is the beginning of an extensive system owned and operated by the municipalities in this section.

A Tribute to George Westinghouse

A booklet containing a tribute to the achievements of the late George Westinghouse, together with an outline of the important events in his life, has been published by the Westinghouse companies, which he founded. The booklet is 4½ by 6 inches in size, is bound in flexible black leather and is of a very simple but rich appearance.



Forging Steel Transoms.

Characteristics of Railway Materials

A Description of Some of the Physical Characteristics of Materials Used in the Mechanical Departments of a Railway

By E. B. Tilt, Engineer of Tests, Canadian Pacific Ry., Montreal, Que.*

A popular description of the physical characteristics of some of the materials used in the mechanical department of a railway should prove interesting to the majority of the members and might lead to some profitable discussion from which we would all benefit. This paper may be too elementary for many and from these we ask their indulgence.

Not all of us could tell offhand how to distinguish a piece of iron from a similarly shaped piece of mild steel, or where we should use bronze instead of white metal, or why a piece of high speed steel can be run at a red heat and retain its usefulness. These and many other questions are not of the same importance to us all, but the explanations are interesting. As my experience has been mainly with the materials used in the construction of rolling stock I shall not discuss those required by the engineering department, which include rails, ties, structural steel, masonry, and so on. I shall not discuss devices either, but confine myself strictly to materials and their attributes.

The principal groups of materials bought for railway shops, nearly in their order of value, are:

1. Iron and steel products.
2. Lumber.
3. Brasses, bronzes and other alloys.
4. Paints.
5. Rubber products.

Iron and steel products cover a very large percentage of the cost and construction of an engine or a car and these may be further subdivided into

1. Steel
   - A. Rolled or forged.
   - B. Cast.
2. Iron
   - A. Puddled.
   - B. Cast.
   - C. Malleable.

Consider a locomotive for a moment. The spring plates, firebox and boiler plates, tires and tubes are made of rolled steel; the axles, side rods and crank pins of forged steel; the frames, frame braces and cross heads of cast steel; the engine bolts and staybolts of puddled iron; the stack, bell stand and small fittings of cast iron; the journal boxes and a few small fittings of malleable iron. If we run over in our mind's eye the materials in a modern steel frame freight car we have cast iron wheels, forged steel axles, rolled steel sills and frames and springs, cast steel couplers and pedestals, malleable iron journal boxes, door locks and stops and minor fittings.

A reasonable question is why are so many different qualities of the same material used, for all iron and steel is originally derived from pig iron made from iron ore. Broadly speaking, cast iron is used in intricate shapes where lightness and tensile strength are not required; where more delicacy and intricacy in design are evident and weight or thickness is a factor malleable iron is used, and where even greater strength is required cast steel is used. Rolled steel and forged steel differ chiefly in the final shaping operation; for example, a tire is rolled on a special type rolling mill, while an axle is forged or shaped under a hammer or press. Wrought iron is principally used in merchant bar, where advantage can be taken of the so-called fiber or toughness of the iron.

It may be well here to mention a very important factor as affecting the value of steel for any use and that is its carbon content. In order to simplify the consideration of this important element in its effect on iron we shall overlook the effect of manganese, a metal somewhat similar to pure iron; of phosphorus most commonly seen as a constituent of the striking head of matches; of sulphur recognized by its yellow color and commonly known as brimstone; of silicon and traces of other metals, all of which form compounds either with each other or with iron which effect the characteristics of the steel.

All are familiar with the effect of carbon in carbon tool steel and its results in making the tool hard when the steel is quenched from redness in some cooling medium.

Low carbon boiler plate must be punched and bent, and low carbon tubes must be beaded, all of which are soft steel as compared with tires which are hard steel and must withstand wear. This hardness affects the tensile strength of the steel as well as its capacity to stretch or have "elongation," as it is commonly called.

On a locomotive, steels are used varying from one-tenth to seven-tenths of carbon, as follows:

.10 to .20	Carbon,	Boiler, firebox plate and tubes.
.2 to .3%	"	Bolts for side rods.
.4 to .5%	"	Side and main rods, piston rods and axles.
.6 to .7%	"	Knuckle pins for couplers which are hardened in oil.
.7 to .8%	"	Cross head keys and tires.
1.0 to 1.10%	"	Spring steel which is specially hardened and tempered.

The reason for low carbon in plates and tubes, giving what is termed a mild steel, is to have a soft, easily working ductile material.

Bolts with .25 carbon cut with a cleaner thread than those with less carbon and have a greater tensile strength.

Axles, side and main rods, piston rods and crank pins with .45% carbon have fair hardness for wear and have good strength.

Knuckle pins, which are oil toughened, have a high shearing value and good wearing qualities.

Cross head keys have a high shearing value, tires are hard for wearing quality.

Springs which are hardened and tempered have a high tensile strength and resistance to fatigue.

Attention is called to an interesting attribute which all the steels and wrought irons have in common, and that is, that if you took the same cross section and same length of bar of each and put the same load on each, the stretch would be the same, provided the elastic limit were not exceeded. The "elastic limit" is that limit which must not be exceeded if the material stressed is to return to its original shape. Steels which have not been hardened have the elastic limit one-half of the ultimate strength; for example, boiler plate with an ultimate strength of 55,000 lbs. per square inch has an elastic limit of about 37,500 lbs., steels which have been hardened have the elastic limit about two-thirds of the ultimate strength. This explains then why making a coil spring harder does not make it stiffer, though it is true that it may bend further and come back to its original shape, as compared with one not so hard.

A widely held idea is that wrought iron is fibrous in structure, while steel is crystalline, and for this reason staybolts which are

*A paper before the Canadian Railway Club.

subject to unknown stresses withstand better if made of iron.

Iron is made by welding many bars together and then rolling them out, and the difference in the amount of work put on these two irons is easily seen. (The writer showed an illustration of a fibrous fracture of iron and a crystalline fracture of the same iron, both depending on whether the nicking extends all around and the bar is sharply broken or not. For comparison a fracture of steel of the typical crystalline kind was shown together with a fibrous, or perhaps more properly called, laminated steel fracture of a spring plate.)

Much is heard about fatigue of metals and a failure of that type is shown in a crank pin which in service is pulled and pushed on two sides only. This is a fracture in detail because failure has taken place in detail or bit by bit. This type of fracture is often mistaken for a flaw in the material. Fractures in detail are common on axles or on any material which is alternately put into tension and compression many millions of times. Failures in detail are caused by overloading, by using too little material or allowing it to be used too long.

Again, material is said to become crystalline due to its use or abuse, which in turn causes failure. This belief in the growth of crystals is probably due to failures of iron, whose fracture showed to be crystalline, whereas a fibrous fracture would ordinarily be expected. In my opinion there is no change in the size of the crystals when temperature is not a factor in the use of material, and that the crystalline face on the fracture is due to the method in which failure was made, that is, the path of fracture has been altered as compared with what it would have been had the metal been fractured new without any use.

There are failures because of an inherent defect in the steel due to a pipe or cavity in the original ingot, and there are a number of other defects, such as blow holes and segregations, which may occur in rolled steel. It is not intended, however, to dwell upon poor material, as it is a very small proportion of the total used.

Cast steel is poured into a mold very much in the same manner as cast iron and is consequently used for intricate shapes where a stronger metal than malleable iron is required. In order to relieve the shinkage strains due to casting and to increase the ductility, steel castings are annealed.

Malleable iron is now confined to small castings, thin in section and complicated in shape. Because of the fusibility of malleable iron at a low temperature, no greater moulding difficulties are found than with cast iron. Malleable castings when poured are chilled as white as the tread of a cast iron wheel, and a long annealing is necessary to give to the iron its malleability and ductility. This malleability is due to the change in the condition of the carbon in the iron.

Cast iron is used for many purposes yet, and the largest castings are locomotive cylinders and car wheels, very few driving wheel centers being made of cast iron now. Cast iron should not be used where it will be in tension, unless these stresses are very low.

There are three principal grades of cast iron for railway use, the softest and weakest being known as machinery grade, and comprising those castings which machine most readily, cylinder metal, which is stronger, and wheel metal, which is used exclusively for cast iron wheels, and the chief characteristic of which is that the iron must be capable of being chilled to form the tread. Now, the interesting thing about these different grades of iron is that as in the case of the grades of steel enumerated earlier, it is the carbon which is responsible for the difference in the irons, only the total amount of carbon does not vary, but its condition does. In steel we have all the carbon in what is termed in the laboratory as "combined," that is, it has combined with the iron to form a compound. In cast iron the carbon is in two conditions, either as graphite showing as black flakes or small black spots, or also as "combined." The total carbon will be in the neighborhood of three and a half per cent, but the combined carbon will vary from half a per cent in machine iron to one per cent in cylinder iron, and to all "combined" in the white or chilled portion of a car wheel. The difference in the test bars gotten from these different irons is all due to the difference in the state or condition of the carbon.

Puddled or wrought iron is so familiar to us all that it will suffice to say that while steel has taken many of the places previously filled by iron, yet the eminent suitability of iron for such work as staybolts and pins to be case-hardened has resulted in its still being used for these and many other purposes. In addition to making a tensile test to determine the strength and ductility of iron, an etched section of the iron is made. This gives additional information as to how well worked the iron is. A test which is being used to distinguish between good and inferior irons is the so-called vibration test. In this test a special test piece is alternately put in compression and tension until failure takes place with a fracture in detail, as previously described in the case of the steel crank pin. Unfortunately, this test is not always conclusive, as differences in testing gives a greater difference of results than the differences in the material.

It is more difficult to tell the difference between iron and steel than the average person imagines, but shearing will very often tell the story, the iron being softer and shearing more readily. When this will not tell, etching will distinguish. Chemically there is usually much difference, for we can compare the two thus:

	Carbon	Sulphur	Phosphorus	Manganese
Iron	.05 to .15	.02 to .07	.075 to .20	Trace to .20
Steel	.10 to 1.50	.02 to .07	.02 to .10	.20 to .80

The greatest difference usually is in the manganese.

A very noticeable difference between mild steel and iron is the poor thread which cuts on mild steel, the metal dragging, while in iron a clean thread is readily cut. Steel makers, in order to make steel that will thread well, purposely leave the sulphur high, and the phosphorus too, and much hexagonal cold drawn steel which threads so well is very poor material. So, too, in working, hot steel is not formed as easily as iron, and it is harder on both machines and dies to work steel than it is iron. The most of the common steel pipe is made from Bessemer steel, which is high in phosphorus, because this steel welds very readily and threads well.

It is often desirable to identify the variety of steel which may be under consideration, to know whether it has been made by the crucible process, the Bessemer process, the acid or basic open hearth process. At the present time the amount of steel made in electric furnaces is relatively small. Expensive steels only are made by the crucible method, say steel costing from 6 cents a pound up, so that price generally determines the use of crucible steel. The Bessemer steel is generally distinguished from the open hearth steel by its higher phosphorus content, 0.7% to 1%, and its high manganese. It is very hard to distinguish between acid and basic open hearth, and its source will often have to furnish the clue. Basic open hearth is usually lower in phosphorus and sulphur than acid open hearth, because it can be so made, but otherwise there is no way of readily telling which one has, either by physical tests or the chemical analysis. Usually it doesn't make much difference, though engineers will be found with preference for acid open hearth because of the initially better stock, from a chemical viewpoint, that is necessary to make it.

In addition to the common steels a number of alloy steels are used. The best known now are vanadium steels, and they may be in any form that steel is supplied, and it will suffice to say that vanadium makes for soundness, and that these steels are heat treated. Where a steel is to be specially treated or "heat-treated," as it is termed, then chromium is also added, the chromium making the steel more susceptible to the effect of quenching. Vanadium steel is commonly used as castings in frames, with chromium for axles, rods, tires and springs, and it has been used in cast iron for cylinders. Manganese steel is most commonly used where much wear is met with, rubbing blocks on locomotives and knuckles of couplers are the principal uses. It takes from .12% to .14% of manganese in the casting, which is after-

wards quenched to give the qualities desired. High silicon and manganese steel have been used for spring steel. Nickel and nickel chrome steels have not attained any great use yet in locomotive and car building.

Alloy steels are much used for cutting tools, and we have the original high speed steels with chromium and tungsten to give the wonderful cutting qualities. Then the addition of vanadium improved these steels and gave a superior class of high speed steels. Latterly cobalt has been added, which made an improvement, so that we have now the double superior steels. No doubt this will give a continued improvement, but it is expected the English language will break down in attempting to supply adjectives to adequately express the quality, so we will be reduced to using a letter, such as is supplied to describe the amount of work done on iron. The custom was to designate as B, BB, or BBB, in referring to the number of times that the wrought iron was worked, and this method has been so popular as representing work that the general public is now worked into accepting steel chain which is described as B, BB and BBB.

The self-hardening tool steels depend largely upon tungsten for their properties. In high speed steels, as in carbon steels for cutting tools, it is our old friend carbon that gives the hardness forming the carbide of tungsten and of chromium, which remain hard at a red heat. The carbide of iron is soft at a red heat, hence high speed steels may be run at a red heat, while carbon steels must be run at a low temperature.

The bronzes, brasses, and white metals are a small but interesting group, and if we think that we know less about them than we do about iron and steel it is perhaps because the latter have received more study and attention. We do not consider a yellow or red metal as any more complex than cast iron, yet, given the analysis of a piece of cast iron and some little history, we will fairly well tell its attributes.

Bronzes may be described as copper base metals with up to .10% of tin and some smaller amounts of lead and zinc, while brasses are a copper base with additions of zinc up to one-third the total weight. The bronzes are used chiefly for bearing metals and steam metals, while the brasses are for decoration. About a railway shop the bronze-bearing metals are usually known as "brasses," which is the old name for any mixture containing copper, but we consider bronzes the better term. Railway bronzes and brasses may vary somewhat on account of the melting of the return scrap, and a consistent effort must be made to keep them up to a given formula. Bronzes and brasses both cast well, and in addition to castings considerable brass in sheet form and pipes is used. The chemical analyses are the checks on the quality of these materials and indicate reasonably well the characteristics of the metals. In bronzes a reasonable strength is needed, and, if possible, total absence of porous or hard spots. In brasses color and soundness are the main considerations. An addition to this class of metals in the last few years is plastic bronze, which is a copper metal containing as much as .35% of lead. This is a satisfactory metal for bearing purposes and is reasonably cheap.

With the exception of locomotive rod and driving box bronzes the other bronze bearings are lined with white metal. The white metal is lead with antimony, thirteen per cent or less, and tin from two to six per cent. The antimony and tin are added to make the lead hard. Here it is well to explain that lead is often termed a frictionless metal, but this is certainly a misnomer. There is no metal which produces more friction than lead does when used alone, but unfortunately it is cheaply hardened by antimony and then becomes of greater value. The value of lead mixtures is the ease with which they change their shape to conform to any alteration in the relative position of the journal and the bearing, and consequently there is always present a large bearing area. Theoretically, the lubricating material, oil or grease, forms a film between the bearing and the journal, and the advantage of a metal which can adapt itself easily to keep this oil film or wedge unbroken and of greatest area must be a valuable bearing metal.

White metals, with tin as the principal constituent, have only a limited use in railway work and are used where the duty is exceptionally severe, either with excessive pressures or high temperatures, as for metallic packings, are a rule. White bearing metals with a high content of zinc are not commonly used, as far as we know. As with bronzes, chemical analysis is the principal way of checking up the quality of the white metals.

The rubber products used by a railway are comparatively small in value but are of much interest. Hose for air, steam and water are the most important, and are now being purchased on specification basis with satisfactory results. As in every other line of industry, the use of scrap must be considered and with the advent of increasing amounts of rubber grown on plantations, the "Fine Para" rubber from the upper reaches of the mysterious Amazon River is forming a smaller part of rubber products than formerly. In hose we look for the cotton duck to give the strength and permit of sufficient flexibility while the rubber protects the duck and makes the hose air, water, or steam tight. As yet physical tests, including stretching and recovery, and the strength tests are the principal ones to gauge the quality of the rubber. The chemical analysis of rubber is more widely done now that standard methods are promulgated by the chemical societies and a reasonably accurate measure of the constituents of any rubber is now readily made and the amount of new and old rubber determined.

Physical tests on the strength of the duck are made, too, so that the physical and chemical tests, together with the knowledge of the physical construction, permit one to make a reasonably good judgment of the service which may be expected from any sample of hose.

The problems of the rubber hose maker are varied, for it can be seen that with rubber compounds and cotton duck he must provide steam hose which must be flexible when used at a temperature of 250° F. or more, while with the same material air brake hose must be flexible at 25° below zero. That this is successfully done is an indication of the skill of the rubber manufacturer.

Paints form one of the interesting groups of materials that the inspecting and testing engineer has to do with, and quite often the paint manufacturer and the chemist are not in agreement as to what constitutes the best paint for any particular job. There are good paints and plenty of them, but likewise there are poor paints and perhaps even more of them. Paint making has not yet emerged from the stage of shop formulae and trade secrets, and until such time as paint making is as open to the engineering world as the iron and steel industry, or as the rubber industry is becoming, there will always be considerable disagreement and dissatisfaction. After all is said, service is what is desired in paint as in everything else that a railway uses, but the great difficulty is to agree upon what constitutes satisfactory service. We might twist the immortal quotation of Bret Harte to fit by saying:

Which I wish to remark—
  And my language is plain—
That for ways that are dark
  And tricks that are vain,
The "Paint-Maker" is peculiar.

However, that viewpoint is undoubtedly unfair to a large industry which includes many honorable manufacturers.

The present most satisfactory way to buy paints is to have a color card, specify the consistency of the paint desired, and leave the rest to the paint manufacturer. In specifying any composition one is usually opening up a fruitless discussion. Linseed oil is still the most satisfactory paint oil and while other oils are being used, and with success, yet linseed oil has not been displaced. Within the last few years there has been much good literature published in connection with paints and much testing work has been done jointly by paint manufacturer associations and engineering societies. Progress is being made and the final result is not as hopeless as these remarks on paints would lead you to believe.

Lumber and timber, while forming an important material, is not on a written specification basis like many other materials. This is bought on grades, men skilled by experience in the working up of lumber judging as to the suitability and quality of the lumber shipped. Specifications are used and merchant lumber associations have definitions of grades and imperfections, but the inspection of lumber will probably remain in the hands of the men who make its production and use their life's work.

In drawing up specifications, the characteristic of materials are described or exhibited by the tests, but sometimes a specification is criticized in that the tests asked for are not those which show the suitability of the material for the use to which it is to be put. For example, the quenching of a piece of boiler plate or boiler tube at a red heat in water and the requirement of subsequent bending without cracking is not anything like what the material is subjected to in use. But this test is a check on the carbon, for low carbon material is desired, and this method of checking the carbon content is quicker even than a laboratory analysis and quite as satisfactory.

An enumeration of the characteristics of materials is not the only thing necessary to insure good material and the manufacturer's assistance in giving "full measure," so to speak, in meeting the requirements, together with the manufacturing skill of his organization, will insure a generally better material than where an effort to just meet or beat the specifications is aimed at. It should be added here that there are still some companies whose pride in quality is greater than their pride in quantity, and given a choice, a disagreement with the former mentioned is preferred. Occasionally the infallible company is met, which, like the king, "can do no wrong," but that is their viewpoint only.

Economies in Freight Car Repairs*

An Enumeration of Twenty-nine Specific Instances in Which Economy Can Be Effected in Repairing Freight Cars

By H. H. Harvey, Genl. Car Fmn., C., B. & Q. R. R.

It hardly seems necessary to say anything about increased size of locomotives, longer trains, rougher handling of cars in switch yards, etc., as compared with conditions only a few years ago, for you are all familiar with these changes.

Neither is it necessary to call attention to the gradual general increase in the cost of freight car repairs or the necessity for economy in everything pertaining to the operation of railroads, as you are all familiar with this also and are no doubt making special efforts to keep expenses down to a minimum in your particular department.

So far as the freight car repair problem is concerned one of the most important questions at the present time is to get rid of short draft timbers extending only to the body bolster and secured to draft sills by only about four ⅞-in. or 1-in. bolts. Cars so equipped are not safe to handle in the heavy tonnage trains in general use on all of our larger trunk lines, and if owners wish to continue them in service, they should placard them and keep them on their own rails regardless of the capacity of the cars.

Only recently I saw a box car that had been given heavy general repairs, repainted and made practically new above sills, and it had six 5 in. by 8 in. longitudinal sills, with short draft timbers depending entirely on the vertical bolts with which they were attached to draft sills. Work of this kind is not economical, nor is it safe, and it should be discouraged in every possible way.

This, however, is not what I had in mind, but it is such a good example of what should be done that I cannot forego the opportunity of mentioning it.

Many economical practices in freight car repairs have been brought out in the past few years and I would invite your attention to some that have come to my notice.

Before mentioning them I wish to state that few, if any, of them are original with me and that most of them are in quite general use on various roads, but they will serve as reminders to bring out others. They are as follows:

(1) Welding or piecing out old bolts. Bolts ⅞ in. and over in diameter can be welded or pieced out to any desired length under a Bradley hammer at a saving of at least $15.00 a thousand and they will give satisfactory service.

(2) Old 1⅜-in. truss rods from dismantled cars may be made into brake shafts by upsetting lower end and truing up drum under hammer, and drawing upper end down to proper size for ratchet wheel for a distance of about four feet. This makes a good stiff shaft, at a considerable saving over cost when made of new iron.

(3) Column bolts for arch bar trucks may be made from old 1⅜-in. body truss rods, by upsetting the two ends about four or five inches, truing up under a hammer and leaving center of bolt 1⅜ in.

(4) Old 1⅜-in. truss rods from dismantled cars may be hammered down under a Bradley hammer into 2 in. by ½ in. flat, 1 in., 1⅛ in. or 1¼ in. round, at a saving of from $5.00 to $12.00 per ton over new iron. This, of course, does not apply where roads have their own rolling mill.

(5) Coupler pockets cracked or broken at rivet holes may be pieced out at considerable saving.

(6) Coupler pockets may be made from old arch bars from dismantled cars.

(7) Draft springs that have taken a permanent set may be heated, stretched to proper length and retempered.

(8) Flanges may be sheared from old truck channels, and the web made into plates for strengthening wooden draft sills between end sill and body bolster.

(9) Brake shafts from dismantled box and stock cars may be cut off and made into shafts for coal and flat cars.

(10) Brake rod jaws from dismantled cars may be cut off and used in making rods for repair work.

(11) Metal brake beams from dismantled cars may be used for repair work on system light capacity cars, or in changing from wood to metal beams.

(12) Very good brake beam hanger supports may be made from old arch bars, which, when riveted to channel type spring plank make an economical way to change from outside to inside hung brakes.

(13) Many malleable castings may be replaced with forgings or pressings made from scrap at shops, at a less cost than price of malleable. Carlin pockets are a good example of this.

(14) Old wrought iron body bolsters may be sheared to size and made into deadwood plates, carrier irons, tie straps and many other things.

(15) A very good bottom brake shaft support may be made from old arch bar tie straps.

(16) The good part of broken sills, and good sills from dismantled cars may be made into sill splices, at a saving of about one dollar per splice.

(17) The bottom two-thirds of short pieces of second-hand sills can be used in making running board saddles, grain strips, blind girth, cripple posts, etc.

(18) Lining from dismantled cars, if carefully removed, can be used in repairing other cars.

(19) Lower course of roof boards from dismantled cars can, if carefully removed, be used in repair work.

(20) Good sheathing on dismantled cars, if carefully removed, may be used below side and end doors, in making end doors for repair work and also for sheathing on bunk and company service cars.

(21) If a road uses grain door nailing strips on inside of side door posts, old flooring from dismantled cars may be used to good advantage in making these strips.

* Extracts from a paper presented before the Western Railway Club on January 19, 1915.

(22) Oak carlins from dismantled cars can be made into first-class outside cross braces for side doors.

(23) Good second-hand brasses may be rebored and relined at considerable saving; if filled brasses are used it is often necessary only to rebore them.

(24) Second-hand nuts, if promptly picked up from around repair tracks, can usually be reclaimed by simply giving them an oil bath.

(25) It pays to remove nuts from broken stub ends of bolts by hand, but it is still better to do it with a machine.

(26) Cracks in floors of box cars can be calked with oakum and much flooring saved.

(27) Use flooring not to exceed six inches in width in box cars and avoid renewal on account of shrinkage cracks that will cause a leakage of small grain.

(28) Use plates at least three inches square under vertical rod heads at side plate and also under heads of bolts going through sills, to prevent them pulling down into plate and sills. This only applies to cars with wooden sills and plates.

(29) The ends of old box cars may be greatly strengthened by applying 1¾-in. end lining, extending from corner post to corner post. Many grain leaks may be avoided by fitting this lining tight to floor at girth.

The road with which I am connected has found it a good proposition to build, at their own shops, from five to seven hundred stock cars per year to use up good material from dismantled cars which otherwise would be sold as scrap. These stock cars are 36 ft. in length with steel center sills and treated intermediate and side sills. In practically all cases we have been able to use second-hand material in their construction, with the exception of the lumber, steel sills, post pockets, brasses, bolts, etc. This second-hand material is carefully inspected, worked over and worn parts removed, so that cars are just as good as if all new material had been used in their construction.

Many of the practices enumerated are in general use, and no claim is made for anything original.

ATTACHMENT FOR HORIZONTAL DRILLING.

By V. T. Kropidlowski.

The writer happened onto the above tool in one of the western shops. It can be used to good advantage for countersinking holes in flanges of black flue sheets, and for a variety of other work of similar nature, whereby time can be saved and work accomplished otherwise impossible.

The body *A*, Fig. 1, can either be drawn out of a solid block, by cutting out the space where the gears go, or it may be made from two pieces of round bar, by splitting them at one end and drawing the split ends out into the required flatness and welding the two shapes together at the flats, then bending the flats to the forked shape, so that the trunnion-like projections, *B* and *B'*, stand at right angles to each other. The sockets in *B'* and *B* can be drilled in a drill press. *B* receives spindle *C*, which has a

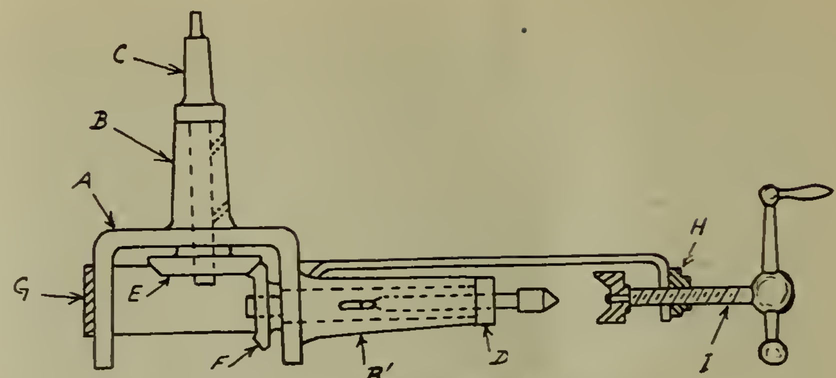


Fig. 1—Radial Drill Press Attachment.

Morse taper at one end to fit the spindle of the drill press, the other end projecting through into the forked part, where it receives gear *E*. *B'* receives spindle *D*, and a regular Morse taper socket is in this spindle for the reception of the drills, it being trunnioned at the other end, where it protrudes through into the forked space, and receives gear *F*, which gear meshes with gear *E*. The yoke *G* is made of flat merchant iron, bent and shaped to go round the forked end of the body *A*, the two free ends being twisted so that the flat surfaces are horizontal and on the level with the top edge of the yoke part, and at the extreme ends these free ends are bent downwards, so as to bolt a cross-piece across them (cross-piece *H*), which carries the feed screw and handle *I*.

Fig. 2 shows the tool applied to a drill press, countersinking holes in the flange of a back flue sheet.

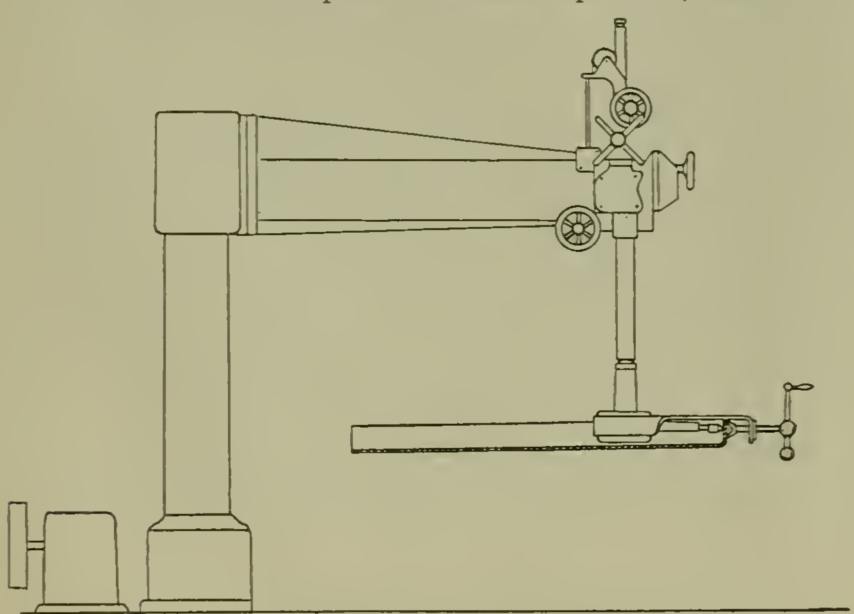


Fig. 2—Radial Drill Press Attachment.

PUBLICITY ON THE B. & O.

How the Baltimore & Ohio deals with the newspapers in matters of public interest concerning its affairs was shown in the case of a train accident recently. When a report reached Superintendent Lechlider that the Chicago-New York express train had been derailed at Warwick, O., early that morning, he telegraphed the city editors of each of the Cleveland papers, requesting that a representative accompany him to the scene or that the local correspondent get in touch with him. The newspaper man at Warwick was given every detail of the accident, in which no one was hurt although the train ran 100 yards along the right-of-way.

THE TIME IS HERE

Railroad buying is active as the larger railroads come into the market for their year's requirements. Especially heavy purchases of spikes and other supplies have been ordered, and several good rail and steel car orders have been placed. The railroads are putting forth every possible effort, apparently, to alleviate the industrial stress by doing as much buying as their resources and needs will permit.

The railroads need revenue. They need extensions. They need new energy. They need equipment. They need credit. They ought not to be compelled to expend most of their strength in fighting off the assaults of political pirates and professional demagogues. Having accepted public regulation in good faith, when they state their case, with evidence to support it, they should be fairly heard and honestly judged. They have been so heard and judged, as their leading representatives admit. Now let them spend their money. It is time to keep promises, to justify arguments, to fulfill expectations. The day of the prophet is at hand. —New York World.

AMERICAN CAR BUILDERS' ASSOCIATION

The American Car Builders' Association has been formed by various car manufacturers to bring about the standardization of freight car equipment, thereby effecting considerable economies in manufacture. The organization is the result of a recent suggestion of the American Railway Association. J. M. Hansen, president of the Standard Steel Car Company, Pittsburgh, is president of the association; W. H. Woodin, of the American Car & Foundry Company, New York, is vice-president, and William Bierman, of the Standard Steel Car Company, Pittsburgh, is secretary.

The Use of Superheaters on Locomotives*

The Particular Value of the Superheater in Railway Service and the Results Which Have Been Obtained by Its Application

By W. M. Ostermann, Asst. to V. P., Locomotive Superheater Co.

The influence of superheating upon the design and operation of locomotives is quite revolutionary, and much more unusual than in stationary power plants. You are all familiar with the engineering refinements that have attended the development of the stationary reciprocating engine and boiler plant.

The keynote of locomotive design and operation has always been simplicity, and railroad men have maintained an attitude of conservatism well founded upon their experience of having had to operate numerous power plants on wheels with a high degree of precision and often under conditions that are adverse to the proper maintenance of any kind of machinery.

However, that there are today in operation about 32,000 locomotives equipped just with the one design of superheater I am going to speak to you about later on, nearly twelve thousand of which are being used on the railroads of this continent, and that a very large percentage of the locomotives being ordered at this time are equipped with the device, is a proof of the fact that the benefits are such that they demand ready appreciation.

The principal reason why an improvement of cylinder performance, or in other words a reduction of the weight of steam per indicated horse power hour, is of particular value for locomotives, is to be found in the limitations of weight and clearance imposed upon the locomotive boiler, limitations which have been felt more and more as the demand for horse power capacity grew. The stationary plant designer has no serious difficulties in proportioning his engine and boilers so as to furnish a certain amount of sustained power. All he needs is money to provide himself with sufficient boiler room space and substantial foundations. His skill is employed for choosing, among the known improvements, a combination that will produce a horse power with a minimum of coal and with the maximum of assurance for uninterrupted service. Fundamentally different is the problem of the locomotive designer. His efforts are directed towards obtaining a certain amount of sustained power with the help of a boiler, the weight of which is limited to what is required for the purpose of adhesion, the cross section of which is moreover limited by road clearance and the length of which is limited by the curves of the track as defining a maximum of rigid wheel base.

Increasing wages of train and engine crews, the desire to increase the operating efficiency of existing track, sometimes inability on the part of the railroads to reduce their grades in pace with the development of the traffic and recently the introduction of steel and steel underframe cars, are factors that are responsible for the rapid growth of weight and power of locomotives in this country.

The average weight has been increasing fast: for instance, it was 112,600 lbs. in 1902, 163,600 lbs. in 1913, and recent figures of the average weight of 1,250 locomotives ordered during 1914 show same to be 286,000 lbs.

A comparison of heating surfaces in stationary and locomotive boilers is very instructive. While a square foot of heating surface is provided in stationary boilers for evaporating from four to seven pounds of water per hour, locomotive boilers have to evaporate as much as twenty pounds and more per square foot of heating surface. Some recent Pennsylvania tests produced evaporations of 23.3 lbs. per square foot of heating surface under forced conditions and with coal as fuel. In view of such extraordinary figures illustrating better than any arguments could the limitations under which steam has to be generated in locomotive operation, the possibilities of relief were tremendous as brought about by any device that could decrease the pounds of steam per indicated horse power hour and that at the same time, which is very important, could be applied without materially impairing the boiler efficiency or greatly increasing the weight of the locomotive. This relief was provided by a correctly designed locomotive superheater.

I am not going to give you a historical outline of the development of the art of locomotive superheating, nor can I mention all of the various existing designs. I will only speak of one which is at present used in the United States in preference to other existing designs, a superheater which is generally called the Schmidt or top-header superheater and of which there are upwards of eleven thousand in use. It is one of the fire-tube or, more generally speaking, of the parallel-flow type, the latter in distinction to the smokebox superheater that operates on the series principle and that, in other words, utilizes the heat of the gases that is left after same have been in contact with the evaporating surface. I wish to mention in this connection that fire tube superheaters of the same general flue arrangement were designed and successfully introduced by Mr. Vaughan of the Canadian Pacific Railway in Canada, and Mr. Cole of the American Locomotive Company in the United States.

Now let us regard some of the results that can be obtained with a correctly designed smoketube superheater. From a combination of the results of tests made by Dr. Goss, the Pennsylvania R. R. and others, we infer that the greater saving at the higher horse power is the direct result of higher superheats obtained. In fact, the superheat increases at a nearly constant rate with the indicated horse power of the locomotives and varies in a generally similar manner with the draft and the rate of evaporation, both of which, as you are aware, are automatically regulated to suit the load of the locomotive through the agency of its exhaust. The superheater is therefore an effective power booster for the locomotive and this is a very valuable feature of it from an operating standpoint. The more steam demand there is made upon the boiler, the more water has to be evaporated per square foot of evaporating surface, the more coal has to be burned per square foot of grate and the more intense is the action of the superheater in decreasing the specific steam consumption of the locomotive. There is an increasing superiority of the superheated engine performance over the saturated engine performance in the curves as the horse power increases. The saturated locomotive boiler does not possess any boosting feature, on the contrary the moisture in the steam fast increases, making the saturated locomotive fall down when forced. The action of the superheater in boosting the steam temperature and power of the locomotive probably finds its limit of benefit at the point where too great an increase of cut-off halts

*Extracts from a paper presented at a meeting of the Chicago section of the American Society of Mechanical Engineers.

a further reduction of specific steam consumption. Just at what speed and power this takes place depends upon the proportions of the boiler, as compared with the cylinders and wheels, and the problem of the designer is to provide the boiler with its proper share of evaporating and superheater heating surface so that the largest possible amount of sustained horse power can be had at the speed at which the engine is required to operate normally.

In a locomotive, the area of the indicator card is indicative of sustained haulage capacity. The larger the card at a certain speed, the more tons one can hang on to the drawbar of a locomotive, and the greater the latter's earning capacity. The addition of a correctly designed superheater to a locomotive makes it possible to greatly increase the area of the card at a certain speed and to therefore increase the haulage and earning capacity of a saturated locomotive, by increasing the cut-off or by "dropping her down," as the engineers say, and still retain the balance between steam generation and consumption.

Savings in coal and water per unit of power developed are now being obtained in every day operation. As a rough average, a coal saving of 25% and a corresponding water saving of 35% can be expected and thermally accounted for with the knowledge that we have of the average amount of cylinder condensation that exists in saturated locomotives.

Comparing two locomotives with identically the same engines and wheels—a case which presents itself often when a superheater is applied to an existing saturated locomotive—and assuming further that it would be possible to take sufficient horse power out of the superheater engine so that it burns the same quantity of coal as the saturated engine per hour without an appreciable increase of coal consumption per indicated horse power developed, then on the basis of the fact that the superheater engine can produce one horse power hour at 25% less coal than the saturated engine, we can inversely figure that the superheater engine has 33⅓% more cylinder horse power and from 45% to 55% more drawbar horsepower available than the saturated engine. In operating terms, drawbar horsepower is tractive power times speed of train. For the same speed of both engines and trains under comparison, the drawbar pull is about proportional to the tonnage, so it would seem that the superheater engine can haul 45% to 55% more tonnage at the speed of the saturated locomotive working at a correspondingly larger cut-off than the latter. Now that is practically impossible due to these reasons. The superheater locomotive has not any more starting effort than the saturated locomotive of the same engine dimensions and particularly on poorly graded roads the starting feature governs the tonnage that can be handled; besides the specific coal consumption increases as the cut-off is increased in a progressive manner, and what share this feature has in preventing too great an increase of tonnage depends upon the cut-off at which the saturated engine had to be worked, whether it was overboilered or underboilered. An increase of speed in order to utilize the greater drawbar horsepower available is often possible in practice. In that case, the drawbar pull increases also per ton of train handled, but I have never heard of a case where all the excess of drawbar horsepower, as potentially existing, could be utilized in practice. Therefore, part of the benefits of superheating must always be reaped in the form of fuel and water saving, and in all practical cases is the fireman bound to save some of his physical efforts.

Before, I stated as much as that the proportions of the superheater within the given locomotive boiler determined the curve of sustained horsepower available at various speeds. These proportions are characterized by the ratio of resistances to the flow of the two parallel streams of gases, the one flowing through the large flues in touch with the superheating and the evaporating surfaces, the other with the evaporating surface only. This ratio is for a given length of boiler equal to the ratio of net internal areas through the large tubes and through the small smoke tubes. Upon it depend the steam temperatures that are obtained in the cylinders at various power outputs, the power boosting and economizing features of the fire-tube superheater. At the present time, they are designed in such a manner that temperatures of about 620° to 650° are obtained for maximum sustained horsepower. The steam temperature is in a manner of incidental interest only, and it is not the purpose of the design to reach a certain temperature. What is wanted is a maximum increase of sustained power from a given boiler. The more large flues and superheater units are applied, the more highly can the steam be superheated, but also the greater is the sacrifice of evaporating surface, and in consequence thereof, the misgivings of the designer of olden days who does not give up a square foot without a fight. The intrusion of the superheater units into the boiler therefore meant a compromise with the boiler man, but as shown the influence of superheating upon specific steam consumption is so great that the net result is a tremendous gain.

It is possible that still greater fuel economies and power increases than at present obtained can be had from the superheater that produces higher steam temperatures, but from what I said before this superheater would not be practical from an operating standpoint unless it can do so with comparatively small sacrifices of evaporating surface. This aim can be achieved with a superheater of a similar, parallel flow of firetube type, that provides for a still closer juxtaposition of superheater and evaporating surfaces, for an arrangement of superheating surface within still smaller smoketubes than the present superheater provides for. In this manner, it is possible to obtain a more effective abstraction of heat from the gases and obtain higher superheats without sacrificing boiler efficiency. Such an arrangement is actually in use now in Europe and its introduction in this country may be possible in time.

A number of problems that presented themselves with the introduction of superheated steam in locomotive operation, such as the obtainance of good lubrication, proper maintenance at roundhouses, et al., were attacked and successfully solved in a short time through systematic efforts on the part of the railroads, problems the discussion of which would lead me too far. There is no logical reason why the problem incidental to the use of still higher steam temperatures could not be solved also.

GENERAL NEWS.

Proposed class and commodity rates from Chicago, Mississippi and Missouri river points and intermediate territory to Utah and common points were declared by the interstate commerce commission to be justified.

The commission approved the higher rates proposed by the Northern Pacific and the Chicago, Milwaukee and St. Paul roads on mixed carloads of cement, lime, stucco, plaster, roofing pitch and salt from St. Paul, Minneapolis, Duluth and points in North Dakota and Montana.

The trustees of the Boston and Maine Railroad have issued the draft of the proposed bill by which legislative authority is asked for the merging of the company and the thirty-six lines it operates under lease. The plan also provides for the elimination of the New York, New Haven and Hartford Railroad in Boston and Maine affairs.

Safety in Crane Work*

A Number of Good Suggestions on a Phase of Safety Work Which Has Received But Little Attention

In a thoroughly modern shop an injury to an operator of a crane is unusual. The crane manufacturer or the shop manager is usually willing to see that every needful thing, of a substantial nature, is provided for the safety of the craneman. A substantial crane cab or cage, containing well-guarded control apparatus, is part of the modern traveling crane. Iron or steel stairways with hand-rails and toe-boards afford safe passage for the craneman from the ground to the cage, and from the cage to the upper deck of the crane. All gears and movable parts of the trolley are supposed to be guarded, safety handles have been designed for the hoisting hooks, and careful inspection aids in keeping the slings and other accessories in proper working condition.

There is nothing of a mechanical nature, however, that will cope with the uncertainties of the human equation in a shop. The workman who does not understand the risks he assumes, or who has a penchant for taking a chance, or who is careless or indifferent, should never be allowed to engage in crane work. Such a man will take a short cut under a load that is being raised or lowered, or he will pass through a narrow space between the load and the wall, when by taking a few extra steps he could easily go by on the wide and safe side, or he will do other equally unwise and unsafe things. The remedy for such conditions lies in education and discipline; and the adoption of special rules and regulations for the craneman and his crew, and of general rules for all other employees in the shop or yard, constitutes the first step in this direction. The foreman of the shop or yard where cranes are in use should make sure by individual examination and inquiry that every employee knows the rules and understands what they mean, and he should be held responsible for the strict observance of them at all times and under all conditions.

A ladder or stairway should be provided at one end of the crane runway in every instance, to give access to the crane cab; and when two cranes are operated on the same runway, ladders or stairways should be installed at both ends. The cranemen should always use these ladders or stairways when going to the crane cages or leaving them. All gears on the trolley and other parts of the crane should be guarded, and no one should be allowed on top of the crane while it is in motion. When repairs are necessary, run the crane to the end of the shop, if possible, and always see that the power switches are locked in the open position before work is started. If other cranes are in use upon the same runway, so that it is not possible to run the damaged crane to the end of the building, see that the safety bumpers are placed at each end of it, to prevent the others from running into it while the repair work is going on.

The bottom of the trolley should have a sheet-metal pan fastened beneath it, to catch any parts that may work loose, and prevent them from falling upon employees on the floor below. Guards should be provided in front of the truck wheels, to remove any obstructions that may be upon the crane tracks, and to prevent injury to persons who may be working upon the tracks. The platform on the top of the crane should be of steel, equipped with a railing, and also with a side board to prevent tools from falling. All electrical wiring for cranes should be enclosed in conduits, and it is particularly important that limit switches be provided, in all cases, for both the main and auxiliary hoists. Keep all tools, oil-cans and waste in a closed metal box, securely fastened to the crane or to the runway at some convenient point.

Woodwork should not be used around a crane, because it is likely to become oil-soaked, and it is then exceedingly combustible. If it should take fire the craneman would have to run the crane to the stairway in order to escape, and the motion would increase the fire and add to the craneman's danger. If he tries to leave the crane in any other way than by the regular ladder or stairway, he will be exposed to hazards of other kinds, and these will be accentuated by his haste.

The craneman should always sound the warning bell before raising or lowering a load, or before starting the crane; and he should never move a load in any direction until a signal has been given by the proper person. The crane crew usually know when a movement is about to take place, and are out of harm's way; but some of them may fail to hear or see the signal when it is given. The sounding of the bell gives definite warning to the worker to get clear, and it also warns the other employees in the shop who are not immediately concerned with the movements of the crane, but who are likely to pass into the danger zone without noticing the crane unless the bell is sounded.

The craneman should never permit any person to ride on the load nor on the slings or hooks, and he should be held responsible for the enforcement of this rule. See that all employees are instructed with regard to this point, and that they know that the craneman has full authority to order them off. If they refuse to leave, the craneman should decline to start the crane, and it should be made clear to him that he will be sustained in this action by his employers. Some craneman, rather than cause trouble between their fellow workmen and those in authority, will disregard the rule and start the crane; but they should remember that they are equally liable to discipline in such cases, and that they share the responsibility for any accident that may occur. It is not kindness to a man to cover up his errors by exposing him to peril of life and limb.

The crane operator should never allow slings, chains, cables or hooks to drag along the floor of the shop, and he should never start the crane carriage until the slings, chains or hooks are entirely clear of the floor or ground. Even in the short distance that the crane might travel before the chains leave the floor, the slings or hooks may become caught on some obstruction and cause an accident.

If the floor of the shop is well filled with workmen, it is advisable to have a man precede the crane and its load by ten or fifteen yards, and give warning to all employees to stand aside till the crane has passed. This is especially desirable when handling truck loads of material, or loads of any other kind which may slip out of the slings from vibration or any other cause.

A craneman should never try to straighten a load by swinging it against a car, building, wall or supporting column. If, after raising the load, he notices that it does not ride straight, he should sound the warning bell and lower the load and let the hookers readjust the slings. Swinging the load against a car or building often subjects the cables or chains to sudden jerks that may increase the stress upon them three or four fold, and cause them to give way. Naturally this greatly increases the likelihood of accidents. The men on the floor cannot read the craneman's mind, and therefore cannot know that he intends to swing the load. They may pass between the load and a car or post without any intimation of danger until it is too late to escape except by lying down; and to lie under a load while it is swung against a post to be straightened appears to us to be about as safe and pleasant as lying in the middle of a railway track and waiting for a string of freight cars to go by.

When a heavy load is to be handled, the craneman should first raise it a few inches to find out whether or not it is well balanced, and to make sure that no undue stress is thrown upon any part of the slings. This procedure will also permit him to test the braking apparatus. If anything is wrong with the brakes or with the adjustment of the slings, the load should be lowered at once, and no attempt should be made to move it until it has received the necessary repairs or adjustments. Caution in this respect is especially important when molten metal is to be handled, even in small quantities.

The craneman in charge of a magnet crane should use extreme care in its operation. With this type of crane the load is held,

* From *The Travelers' Standard.*

not by slings or chains, but by the intangible force of magnetism; and the complete shutting off of the electric current, or any marked decrease in its strength, will let the load drop immediately and without the least warning, with serious results to any person beneath. Whenever it is possible to do so, arrange to make the current supply for a magnet crane entirely independent of all other power or lighting circuits, in order to avoid interruptions of the supply that might otherwise be caused by trouble in other parts of the circuit. Magnet cranes should not be used inside of buildings, nor in any location where they will pass over workmen below.

Cranes of any kind, and particularly magnet cranes, should never be stopped over a passageway unless men are stationed at each end of the passageway to warn employees. All employees should be instructed with respect to the principle underlying the action of the magnet crane, so that they will realize the special danger of standing or passing beneath the load. Even if the magnet has no load, but has the power on, a man passing close under it may be exposed to danger if he is carrying steel or iron on his back or shoulders. If the metal comes near enough the magnet will draw it up, and the action is so quick and unexpected that the man may also be lifted before he has time to release his hold. In any such case the first and most natural impulse of the craneman is to shut off the current; but if he does so, he immediately destroys the attractive influence of the magnet, and the steel or iron that it has seized falls back again upon the workman, very likely with serious consequences.

When a magnet crane is exposed to the weather, make sure that the electrical conductors are in first-class condition at all times. Conductor losses or leakages during damp or rainy weather often weaken the holding power of the magnet. In the winter months ice is likely to form on the power rail or the trolley wire, and when the brush on the power rail or the wheel of the trolley reaches the icy section, the contact becomes broken or imperfect, and the load usually drops. It is therefore highly important to keep the conductors free from ice at all times.

The majority of what may be termed "minor injuries" among crane workers occur in connection with hooking up or unhooking the loads. It is not at all uncommon for workmen, after applying the hooks to a load, to hold them in place with their hands until the slack of the hoisting cable is taken up and the hooks take a good grip. The point of contact and the angle which a hook makes with the load usually change somewhat the instant the weight is lifted, and unless the workman anticipates these changes his fingers or hand are quite likely to be caught, and perhaps crushed or cut off. In many of our industrial plants safety handles are attached to all hooks used in crane work. We strongly favor the use of such handles, because they enable the workmen to hold the hooks in place with safety until the load bears on them. In shops where safety handles are not provided, the workmen should use notched pieces of wood of convenient size. By pressing the notched section against the hook, the latter can be held in place without danger of crushing the hands or fingers, and the men are also free from danger in case the load suddenly slips or twists around, or in case a part of the hoisting apparatus breaks.

The hookers and the craneman should work together, to see that both the crane and the crane trolley are directly over the center of the load to be handled. If either one is off center, the load will swing when it is raised, and will be likely to injure anyone in its path. When the hooks or slings are in place and the slack is taken up, the workmen should immediately stand back several feet from the load.

The hookers should never, under any circumstances, stand inside a car into which material, approximately as long as the car, is to be lowered, or from which material of similar length is to be raised. The margin of space at the sides or ends of the car is then small when compared with the uncertain length of the swing of the load, and the craneman (particularly if the cab is at one end of the crane and the material to be lowered into the car at the other end) may easily make a mistake of a few inches in manipulating the load. As the load is lowered it may bear for a fraction of a second upon the side or end of the car, until its own weight pulls it away with a swinging, jerky motion. A miscalculation of the position of the exact center of the load, with respect to the center of the trolley, will also cause the load to swing when it is raised. Under either of these conditions the men in the car have little or no chance to escape injury. In fact, the safety zone in a car is so limited that it is better for the workmen to remain outside, even though the material handled is only half the length of the car.

The man who will stay in a car when a large load is being handled, has his counterpart in the man who will continually go into a narrow space between a load and a neighboring wall or post. It is often necessary to place a load twelve or eighteen inches from a wall, but it is not necessary for a workman to get into this space while the load is being raised or lowered. The load will probably come to rest without any mishap, but the workman has no guarantee to that effect. The cables may twist and swing a corner of the load around, crushing the man in the narrow space; or a block of wood or some other unnoticed object may be lying on the floor just where the load is to be placed and when the load is lowered this obstacle may cause it to tip far enough to kill or seriously injure the workman on the narrow side.

The sheave or block to which the hook is secured should be effectively enclosed, to prevent the hands of workmen from being drawn into it when slackening off the cables. So far as possible, the hooker should avoid trying to loosen a cable by pulling it down on the inrunning side of the block. His fingers may be caught between the sheave and the chain or cable, and be cut off or badly crushed. It is far safer to grasp the outrunning side, and pull up and away from the sheaves or pulleys.

The crane crew and all other employees in the vicinity should keep well away while the chains or cables are being withdrawn from under a load, because they may catch and tip the load over. In such an event the action is sometimes so quick that the men have little opportunity to get out of the way. Sometimes a chain will catch on the load, but not firmly enough to tip it over, and as the steady pull of the crane overcomes the hold of the chain the latter will fly out suddenly and with great force. We have frequently seen chains jerked from under loads, in this way, with sufficient force to cause instant death if one of the links should strike a man on the head.

Another prolific cause of accidents consists in men working on the crane runways without taking sufficient precautions for their own safety. When a man is obliged to work on a runway, he should first of all notify the craneman, but he should not depend on this warning as his sole protection against being run down by the crane. The craneman may forget the workman, or he may misjudge the speed or distance, and so run the crane against him. A warning flag should be placed on a nearby column in plain sight of the craneman, and buffers should also be clamped to the crane rails a few yards from the point where the work is being done. If the craneman then forgets the man on the runway, and also fails to note the warning flag, his attention will be forcibly directed to the matter when his crane strikes the buffers. If no buffers are supplied, the workman should have a stout rope safely fastened in a convenient place, so that he may easily slip down to the ground in case of danger.

In plants having machine-shop galleries located beside crane runways it is important to screen off the runways from the galleries for their entire length.

The foregoing are some of the most common and important causes of accidents in crane use, and they can all be avoided, as we have tried to show, by the exercise of proper care. The installation of safety devices will help greatly in this direction, but educational and disciplinary measures are even more important, because many of the workmen know about the various hazards that we have mentioned, and yet fail to observe the safety rules that would prevent the consequent injuries or reduce them to a minimum.

Dynamometer Car for Japanese Railways

A Car Recently Designed and Built in This Country Which Embodies Every Up-to-date Feature for Test Work

By E. C. Schmidt, Prof. Ry. Engr., University of Illinois.

Some months ago the writer was commissioned by the Imperial Government Railways of Japan to design and to have built in this country a dynamometer car. This car, which was completed and shipped during the past summer, has recently arrived in Japan. This article aims to present only a general description of the car and its equipment, while the illustrations are relied upon to convey some idea of the details to those interested. The general dimensions and the general specifications of the car were laid down by Mr. S. Matsune, chief of the motive power section of the Government Railways. In the choice of the car design and of the type of equipment, as well as in all details, the designer was left free to follow his own judgment.

Like most other dynamometer cars, it was designed to measure and to record data needed in making tests to determine train resistance and tests of locomotive performance on steam roads. It is accordingly equipped to record drawbar pull, drawbar work, speed, time, distance traveled, position of mile-posts and stations, the direction and velocity of the wind with respect to the car, and the vacuum in the brake cylinders. In addition to these records, it is possible on occasion to record also much data of locomotive operation as the time of taking indicator cards, the position of reverse lever and throttle, locomotive boiler pressure, and so forth.

The car itself is 47 ft. 10 in. long over the buffers, 8 ft. 6 in. wide overall and 12 ft. high. It has therefore a somewhat smaller cross section than the ordinary American passenger coach and resembles more our interurban cars. The underframe and platforms are of steel, the body of wood and finished within in quartered oak. The trucks are of 3 ft. 6 in. gauge, of all-steel construction and suitable for high speeds. The car has the buffers, vacuum brake, and hook and link couplers, which are common in Japanese railway practice. Thirteen feet at the rear end of the car are occupied by a berth section, lockers, and lavatories, leaving a workroom 7 ft. 9 in. by 27 ft. long which contains the recording apparatus, work bench, desk and other equipment. The car is equipped with an axle generator and storage battery which furnish current not only for the lights but for the motor and magnets incorporated in the recording apparatus, and for other electrical equipment.

Motion for all apparatus within the car is obtained, by means of gearing, from the axle of an auxiliary truck located behind the forward car truck. This truck carries a pair of small wheels on a single axle, whose directional relation to the car axis remains fixed, thereby permitting a simpler arrangement of gears than if the motion were derived from one of the axles of the regular trucks which have a considerable motion with respect to the car axis. Furthermore, since the wheels of the auxiliary truck are not subjected to brake shoe action, their diameter changes much less rapidly than the diameter of the regular truck wheels and consequently the speed of motion of the apparatus within the car is subject to less variation and correction than if the motion had been transmitted from one of the regular truck wheels. Provision is made for raising the wheels of this truck from the rail when the apparatus within the car is not in operation, and all gearing is therefore out of action except when it is actually doing useful work. A similar device has been in successful operation on the dynamometer car of the University of Illinois for the past eight years and it has been retained in this design for the reasons here suggested.

Fig. 2—Dynamometer Car for the Japanese Railways.

The dynamometer for measuring drawbar pull consists essentially in an oil-filled cylinder mounted on the center sills toward the front end of the car. Through a yoke the piston of this cylinder is connected to the car drawbar and consequently the whole pull of the locomotive upon the car is received against the

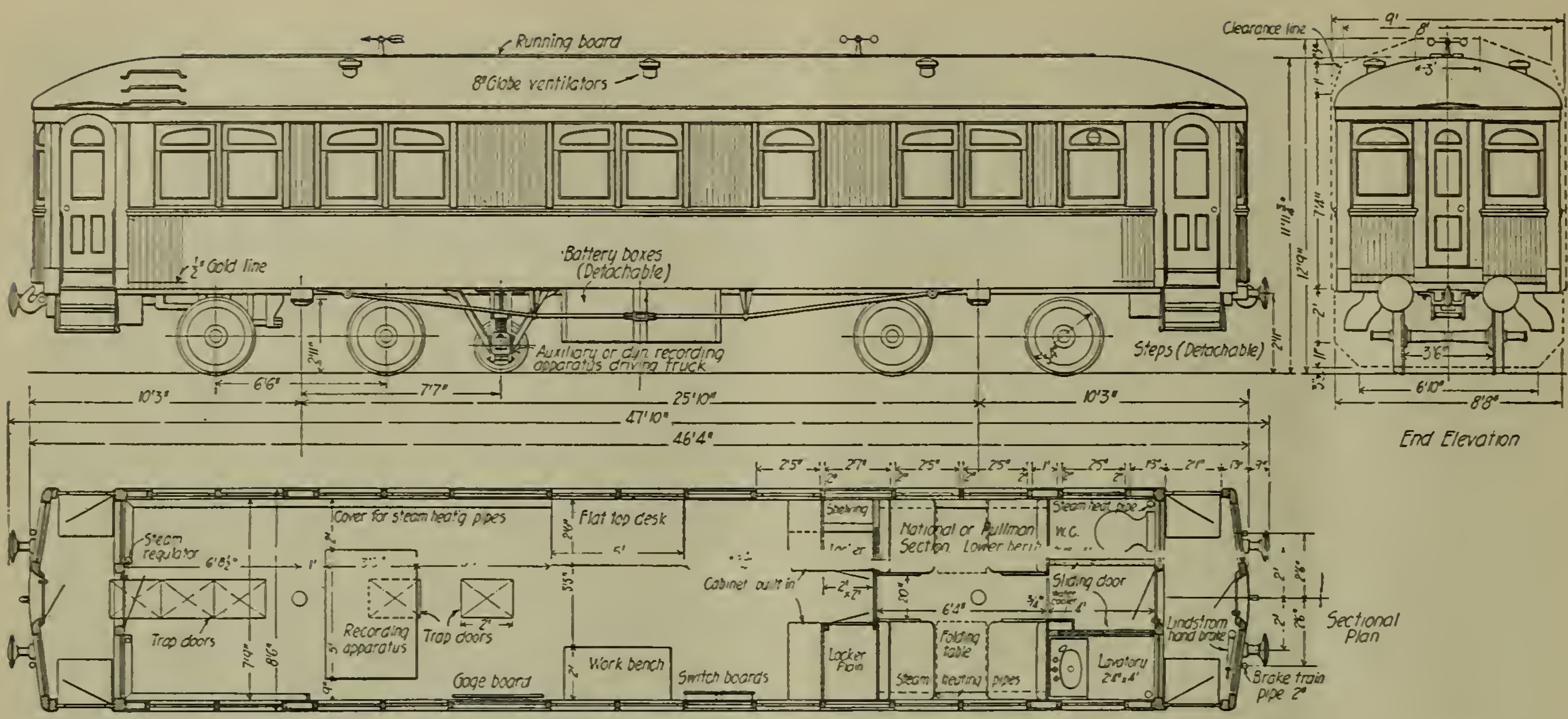


Fig. 1—Plan and Elevation of Dynamometer Car.

oil in the cylinder. The pressure built up in this oil is transmitted through a ¾-inch pipe to a small indicator which is located on the recording table within the car, and whose design resembles that of the ordinary steam engine indicator. In order to avoid the friction arising from piston packing, the dynamometer cylinder and its piston are ground to a nice fit and no packing is used. The maximum pull to be registered by the car is 80,000 lbs. The sectional area of the dynamometer cylinder is about 91 sq. in. and the maximum working pressure in the oil, therefore, will not exceed 880 lbs. The springs in the indicator may be changed from test to test to correspond in strength with the maximum working pressure in the oil. Apparently the use of a hydraulic cylinder in a dynamometer car originated with P. H. Dudley, who about 1879 installed such a cylinder in a car which he then operated on the New York Central Railroad. The use of this type of dynamometer, which has many advantages over the ordinary spring dynamometer, was revived at the University of Illinois in 1898 when it was incorporated in their first test car. It has since been used rather generally in the dynamometer cars built for American railroads.

The general design of the dynamometer mechanism is shown in

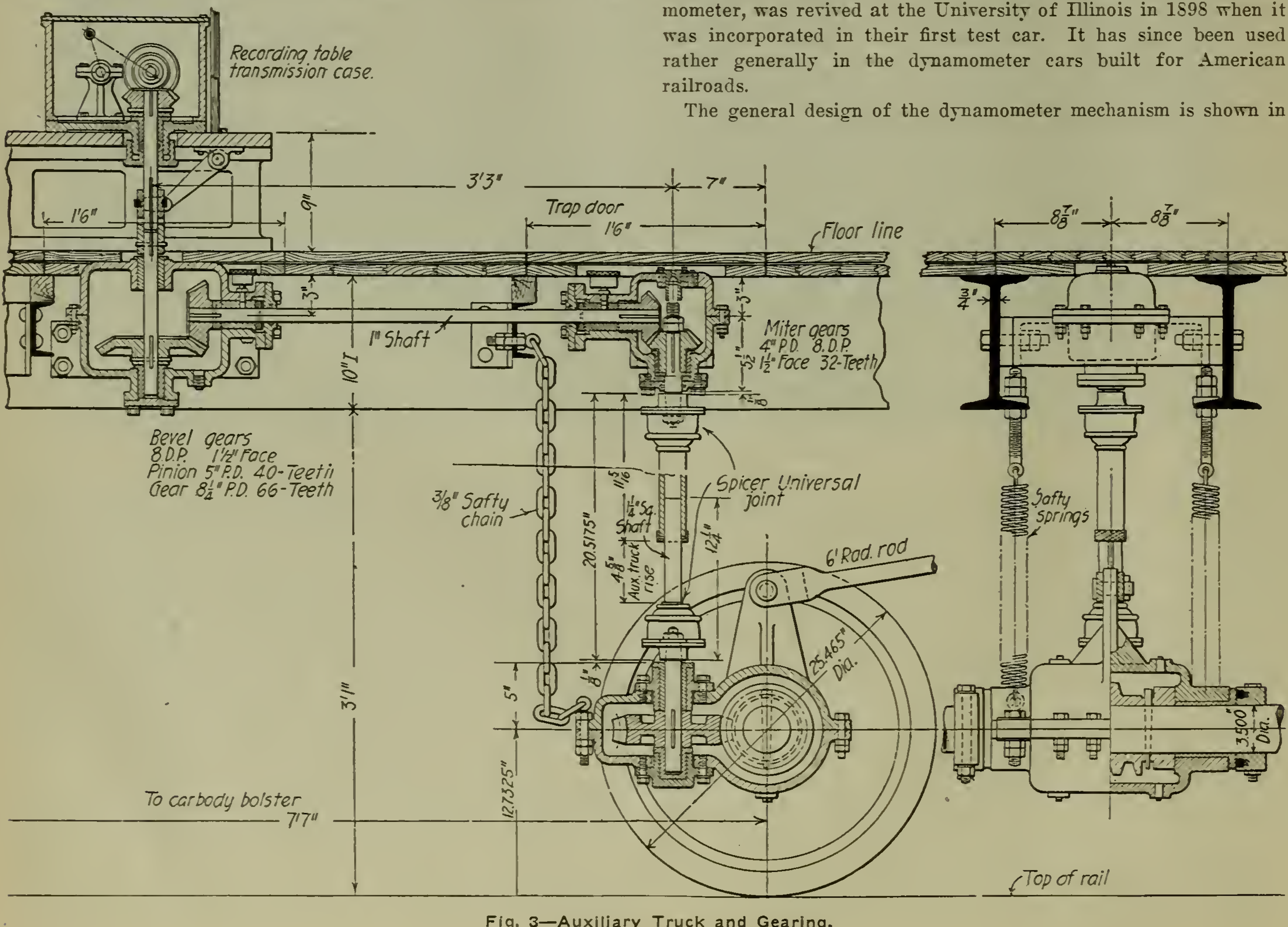


Fig. 3—Auxiliary Truck and Gearing.

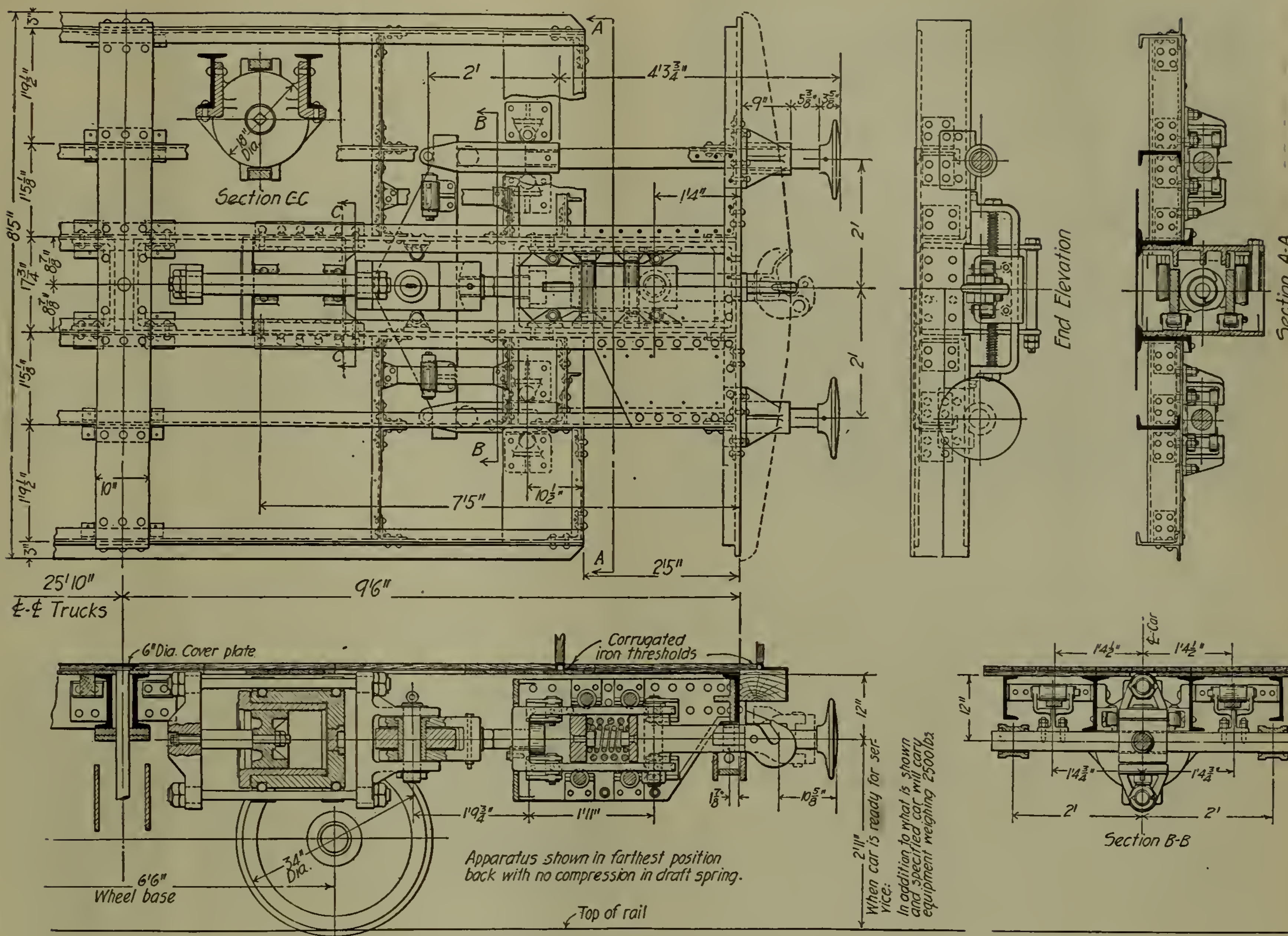


Fig. 4—Dynamometer Machinery and Portions of Underframe.

one of the accompanying illustrations. This design has been somewhat complicated by the fact that the owners insisted on retaining the ordinary buffers, even though it should prove necessary to separately register on the record the amount of the buffer thrust. It has proved feasible, however, to avoid so recording the buffer thrust and the operation of the car has been thereby considerably simplified. To accomplish this there is provided in the drawbar mechanism an equalization lever which swivels on a pin carried in the central axis of the drawbar yoke. The buffers instead of having their seat in the car frame, deliver their thrust against the ends of this lever. The thrusts on the buffers, therefore, merely set up in the drawbar mechanism internal stresses which are not transmitted to the dynamometer cylinder, and the buffer thrusts in nowise affect the pull record. The arrangement is more easily understood by reference to figure 4.

All parts of the buffer and drawbar mechanism are carried by rollers to minimize friction. For the same reason the piston of the dynamometer cylinder is not packed as above stated and, as a result of this, a certain leakage of oil takes place past the piston. To compensate for this leakage, oil must be pumped into the cylinder. This may be done even while the car is in operation by means of a hand operated pump which draws its supply from an oil reservoir within the car. The leakage from the cylinder is received in a drip tank and is returned thence to the oil reservoir by means of compressed air, which is supplied by a small motor-driven compressor located within the car.

All records are made on a continuous strip of paper 30 in. wide, which moves over the surface of the recording table shown in figures 5, 6 and 7. In this recording machine the motion is received from the auxiliary truck and transmitted to gearing contained in the gear case shown on the base of the table. From this gearing motion is communicated to the rollers which drive the paper, to the speed recorder, the speedometer, and the work recorder. When desired, the paper may be driven by means of a motor mounted on the table base; in which case the records are made on a time base instead of on a distance base. When driven from the truck below the car, the paper travels either $\frac{1}{16}$ in., ¼ in. or 1 in. for each 100 ft. of car travel. When driven by the motor, the paper travels at either 5 in., 20 in. or 80 in. per minute. As may be seen in figure 7, all the pens for the various records are arranged to travel in the same straight line. Datum pens arranged in front of these lines draw base lines for the records of pull, speed, wind direction and brake cylinder pressure. These four records are drawn as curves by pens which are mechanically connected to the pull indicator, the speed recorder, the wind vane, and the brake cylinder indicator. All other records are drawn as straight lines with offsets occurring in the lines at certain intervals. The pens for these records are all controlled through the medium of electro-magnets.

The speed record is obtained by means of a Boyer speed recorder mounted on the base of the table and directly geared to one of the spindles of the main gear case. The motion of the speed recorder piston rod is transmitted to the upper surface of the table and transformed from vertical to horizontal motion by means of a slotted bell-crank which moves a small carriage on the top of the table shown at the right in figure 7. This linkage suffices also to increase the normal maximum travel of the Boyer gauge from 3 in. to 6 in. Provision is made for driving this instrument at twice its normal speed. For low speed tests, the speed recorder is run in high gear and for high speed tests, in the low gear. The shift from high to low gear may be accomplished either by one of the operating levers or by means of an electrically operated clutch which goes into action when the speed curve pen reaches the limit of its travel. By these means the average ordinate of

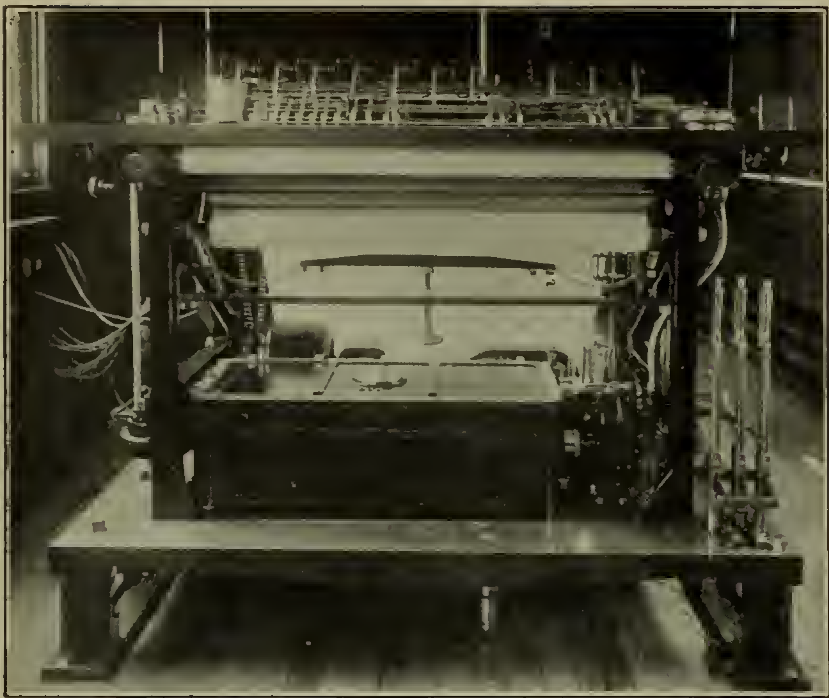


Fig. 5—Front View of Recording Table.

the speed curve may be kept as great during a slow speed freight run as with a high speed passenger train, the scale of the record being, of course, different in the two cases. In addition to the speed recorder, upon whose record all calculations are based, there is provided for convenience in determining momentary speed a speedometer such as is commonly used on automobiles. These instruments have a range up to 85 miles per hour, and it is expected that the car will occasionally be operated at that speed.

Wind direction with respect to the car axis is recorded on the chart by means of a wind vane mounted on the roof of the car. The spindle of this vane projects downward to the recording table where, through a crank and yoke, it is connected to the wind direction pen. This pen draws a curve whose ordinate is the sine of the angle made by the wind vane with the longitudinal axis of the car. The wind velocity record is obtained by means of an anemometer of the pattern used by the United States weather bureau, which makes its record on the chart through the medium of a pen controlled by an electro-magnet.

The pen which draws the record of pressure in the brake cylinder is carried on an extension of the piston rod of a small indicator similar in design to an ordinary steam engine indicator. The cylinder of this instrument is connected with the main cylinder of the vacuum brake and the curve drawn is therefore one whose ordinate is a measure of the difference between atmospheric pressure and the pressure in the brake cylinder. The record of distance traveled is made by a pair of contact points placed on one of the gears of the main gear train which makes one revolution for each 1,000 ft. of car travel. These contact points control an electric circuit through one of the magnets, which in turn controls the distance pen.

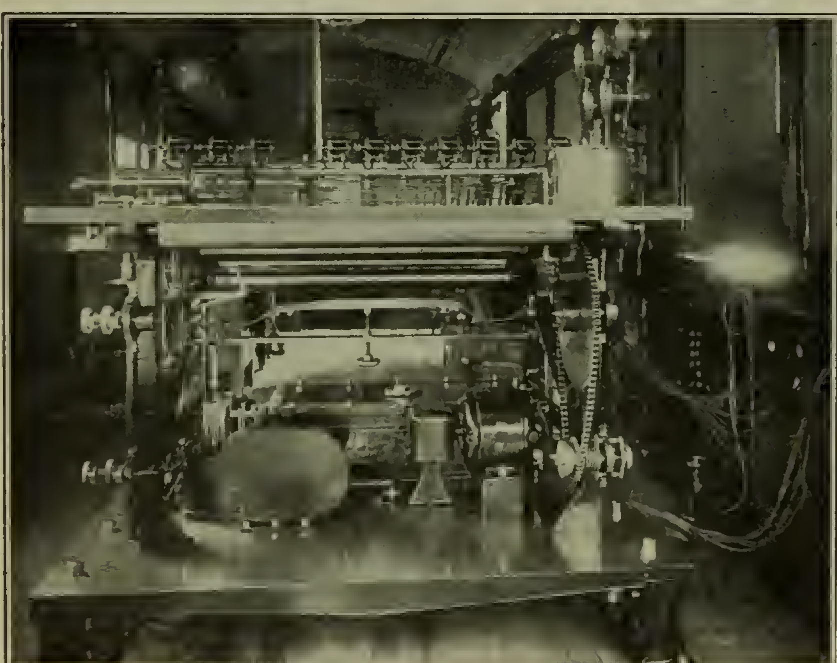


Fig. 6—Rear View of Recording Table. The Paper Rolls Have Been Omitted In Order to Give a Clear View of the Mechanism.

It is frequently desirable in calculating train resistance from dynamometer car records to know the total work performed at the drawbar. To record this work continuously on the chart obviates the burdensome task of otherwise measuring the area under the curve of drawbar pull, which in many cases involves operating a planimeter over a record from one hundred to one hundred and fifty feet long. Many dynamometer cars have for this reason been equipped with some form of planimeter whose purpose is to automatically record the area included between the curve of drawbar pull and its datum line. The design of the work recorder or planimeter used on this car is shown in figure 8. It consists essentially of a finely ground steel cylinder which is in contact with and is rolled by a ground spherical surface. The spindle which carries the segment of the sphere shown in the photograph bears a fixed relation to the table. By means of gearing this spherical segment is driven at a rate proportional to the travel of the paper. The cylinder, on the other hand, is carried in a frame so pivoted that it may be turned about a vertical axis. To this frame near the bottom there is attached an arm, a portion of which appears in the photograph. This arm terminates in a wheel which plays in a slotted carriage carried on the end of the rod attached to the drawbar pull pen. The carriage may be seen at the left side of the table in figure 7. By means of these connections, any movement of the drawbar pull pen results in a corresponding change in the angle of the frame which carries the rolling cylinder. The cylinder is kept continually in contact with the sphere by means of a spring attached to the cylinder frame. When the instrument is in operation, the spherical surface, as previously stated, revolves at a rate proportional to the travel of the paper chart, and the angle which the cylinder makes with the axis of the sphere depends upon the length of the ordinate of the curve of drawbar pull. The roll of the cylinder which is directly proportional to the speed of revolution of the sphere and to the tangent of the angle which the cylinder axis makes with the sphere axis, is consequently also proportional to the paper travel and the pull curve ordinate. In other words, the roll of the cylinder is proportional to the area included under the curve of drawbar pull. The proportions of the instrument are such that for each 3 sq. in. of area the cylinder will make one complete revolution. To record the roll of the cylinder on the chart, there is provided on the flange carried on the end of the cylinder a small projection or button which closes a pair of contact points once during each revolution of the cylinder. These contact points form the terminal of an eletric circuit which passes through one of the magnets carried on the bridge on the table

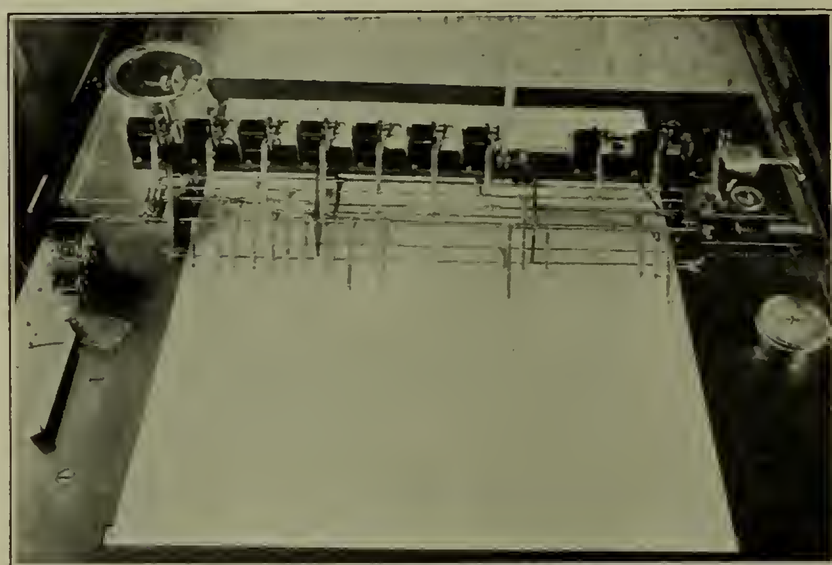


Fig. 7—Top of Recording Table Showing Pens.

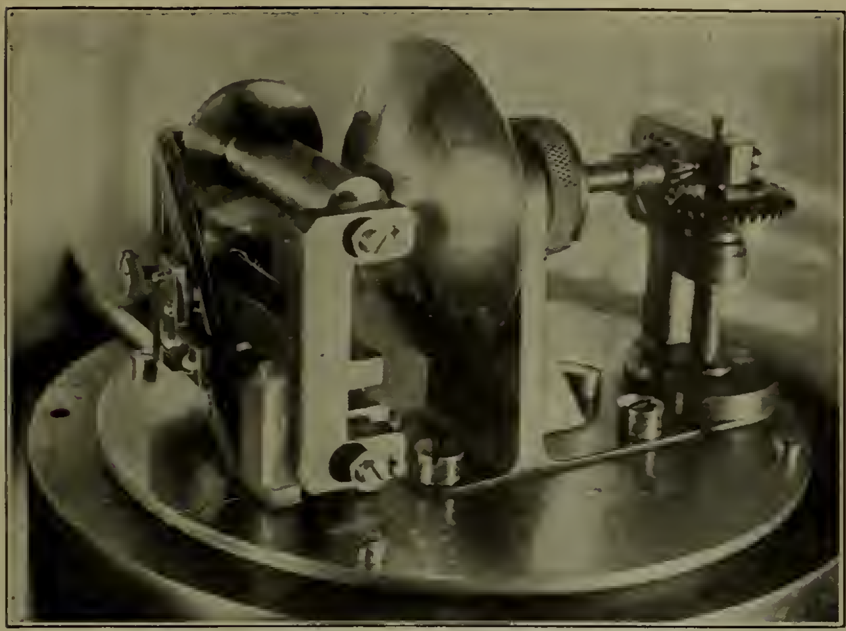


Fig. 8—Work Recorder of Planimeter with Cover Removed.

top. The armature of this magnet is connected in its turn to the pen which makes the work record. This pen draws a straight line which is interrupted at each revolution of the work recorder cylinder by a small offset. The distance between these offsets corresponds to 3 sq. in. of area lying between the draw-bar pull curve and its datum line.

The time record is made at both edges of the chart by means of two pens mounted on one rod which is operated by the cam and magnet mechanism shown at the left of the recording table (see figure 7). A clock making electric contact every five seconds controls these magnets which in turn operate the pen rod through the medium of a pair of cams. The design is such that the record distinguishes not only five-second intervals but one-minute intervals as well.

Such other records as the position of mile posts, position at which indicator cards are taken, reverse lever position, throttle position, locomotive boiler pressure, etc., may be made on the chart by means of a number of extra pens whose arms are connected to the armatures of electro-magnets mounted on a bridge across the table top. These magnets are controlled by means of push buttons located either in the car or on the locomotive. The wiring for such electric connections is permanently installed in the car.

Upon the suggestion of the owners, the car was designed so that it could be knocked down for shipment. In a car of this nature, this requirement has, of course, considerably involved the design and has somewhat increased the cost of construction. The cost of reassembling the car in Japan will also doubtless be considerable. Investigation indicated, however, that these disadvantages were more than sufficiently offset by the very high freight which would have been charged for transporting the entire car as a deck load and by the extra insurance rates which would have been charged had the shipment been carried in that way.

As additional evidence of Japanese progressiveness, it may be of interest to add that the Japanese Government Railways have also recently installed near Tokio a thoroughly equipped laboratory for testing locomotives. With this plant and the dynamometer car, the Japanese railways have at their disposal for experimental study of the problems of locomotive and train operation, facilities which are equalled on only one American railway.

The Lubrication of Freight and Passenger Car Journals*

The Influence of Bearing Surfaces, Wedges, Oil Boxes, Trucks and Track Condition on Journals of Freight and Passenger Cars

By W. A. Clark.

The history of railroading tells us that from its inception, trouble, delays and serious damage has occurred from the overheating of car journals and brasses.

The records of the engineering and mechanical associations show that they have for years worked for progress by striving to improve the practices in this particular field of service.

Under different headings and in a general way, we will present for consideration some of the things that enter into and make successful lubrication possible, as against some of the causes that produce other experiences. Theory and practice must, necessarily, go hand in hand.

Lubrication, like other problems, should be worked out systematically, the results summarized and used as a guide in practice.

Journals and brasses must be smooth and true; brasses of the proper diameter and of strength to resist spreading, or closing, under the maximum pressure imposed.

Wedges should be correct as to dimensions: if too large, having a crown bearing only, thus reducing the area of contact, concentrating load on top or to the side, causing excessive friction, with a rapid heating of brass and journal. Under heavy capacity cars, if wedge has a side bearing and not a crown bearing, it will cramp brass to side of journal and cause heating.

Oil boxes are a factor in lubrication. There are a variety of designs, shapes and sizes and different results are obtained from the extremes in either case. Some boxes are very narrow, making it difficult to place, or keep the sponging in proper position. There are other boxes considerably larger that allow the sponging to become disarranged to the extent that it soon works away from the journal. There are boxes that after they are properly packed, the sponging will have very little movement.

Should excessive friction develop between brass and journal, trouble manifests itself when the temperature rises more rapidly than it can be absorbed by the metals in contact, resulting in its soon reaching the danger point, or where the lubricant ceases to be effective. At this stage the oil volatizes, or passes off in vapor, consequently it does not reach the parts under pressure. They in turn seize, increasing the friction, thus increasing the heat until brass breaks or melts. With the journal bearing surface destroyed, if kept in motion without attention, the heat will increase until journal is burned off, or broken.

Trucks should be square and true, or brasses may be forced against box or fillets, or against or on top of collar. The box may be out of line with the result that heating will occur in proportion to the freedom that brass has, or the amount that truck is distorted.

The above items may be considered as being purely mechanical influences. When they exist unduly, successful lubrication cannot be obtained until mechanical defects are remedied.

To the average individual a heated journal is assumed to have been caused from a lack of oil. Few ever look further, or appreciate the fact that although packing may appear dry on the top, there may be ample oil in the bottom of box. However, there are a number of causes with a combination of conditions other than a lack of oil, that do produce hot boxes.

* A paper delivered before the Missabe Railway Club.

One of the principal causes of hot boxes is the working or moving of the sponging or packing. The lateral movement forces the packing away from the inside, or fillet end of journal. It must follow that a surface in contact under pressure and revolving will generate heat at the point where packing and oil do not touch the journal. This heat is conducted to the full length of bearing and in time causes a hot box. This is a difficult condition to detect from an outside examination of box. It can be discovered and corrected by using the packing spoon to replace or put packing to back end of box and in contact with full length of journal. The pouring of oil in a box that is running hot from this cause will only give temporary relief unless the packing is first pushed back so as to touch, or be in contact with the full length of journal.

Another point is, that the oil box as used on railway equipment, cannot be half, or even one-quarter filled with oil, for the reason that the hole in the back of box is about 1½ inches from the bottom. When this level is reached the oil can run out at back as fast as it might be poured in at the front.

This should show the necessity of having a good grade of saturated waste placed and kept in the proper position in oil box. It should be a practice when examining boxes, or when they show signs of heating, to use a packing spoon to put sponging back in contact with journal.

The most important element in the lubrication of car brasses is that the oil be conveyed to every part of the journal.

Axles and journals as now made from steel, give little trouble. The percentage of hot boxes originating from journal defects are small.

The brass or bearing has a direct influence on the manner in which a journal will run. Every precaution should be taken to procure a perfect fit with a grade of bearing metal suitable to withstand severe service. In following up and investigating hot box reports, a number of brasses that caused trouble were examined. In nearly every case the lining had worn away at the center and not at the ends of the brass, due to a variation in the structure of the brasses. On breaking brasses longitudinally for examination, they were found to consist of a different mixture at the center than at the ends. Others were found that were not solid, or had longitudinal fissures or flaws. The difference in the rigidity of the metal in the brasses induced an unequal distribution of the pressure. Abrasion occurred at the middle, causing excessive heating and a hot box. Foundry practice should aim to have the metals mixed in the proper proportions and heated to a temperature to make the finished bearing of good, clean homogeneous metal of equal hardness all the way through.

The question of foundry practice, or the care exercised in manufacturing car brasses is one of the most important features in furthering perfect lubrication. Brass foundry practice is still so dependent on empirical laws that it is difficult to reach definite conclusions as to the exact nature of the alloys to produce the best car bearing. So much depends on the methods used, or treatment given, that a chemical analysis if of no great value as a guide to any rigid formula. The same ingredients differently treated will produce bearings of a marked variation. This being the case the foundry that gives close attention to the proven practice will make the most suitable brasses, having strength, solidity, toughness, and good anti-frictional qualities.

I have noted brasses that have been in service on 100,000 capacity ore cars eight to ten years, with a mileage of from 80,000 to 90,000 miles, that did not show any marked abrasion or wear. I have also noted other brasses that received the same care and treatment in the same class of cars and service, yet showing marked wear and abrasion with very short service and mileage, in fact, had to be removed account of not being in condition for further service.

This might appear to conflict with some of the theories in the matter of friction and lubrication, but it clearly demonstrates that certain mixtures, or the treatment of same, gives longer life with less abrasion and wear when used in comparative service.

With the use of the proper grade of oil it is assumed that the lubricant prevents any contact of the metal bearing surface. On this point there may be a question as to which law of friction governs. At times it may be the law of friction of solids, that is, independent of the surfaces in contact, but dependent on the total pressure. Or the law of friction of liquids, that is, independent of the pressure per square inch, but is directly dependent on the area and increases as the square of the velocity.

Journal friction consists of the load on the journal, times the coefficient of journal, times the diameter of the journal, divided by the diameter of the car wheel. The coefficient of journal friction is the one quality that is affected and variable to the extent that it is increased or decreased by the conditions and application of the lubricant, or, it is affected jointly by the bearing metals in contact, or by the metals and oil interposed.

Dross or sand when mixed with the bearing metal cause heating, unequal hardness, or, what is termed "hard spots," cause heating from the fact that the soft metal wears away, concentrating the pressure on the high spots, causing excessive friction with a rapid rise in temperature and ultimately a hot box. The only remedy for this trouble is to change the brass.

About the year 1885 the practice of using a lead lining 1/16 of an inch thick was tried on car brasses. A few years later it was adopted as a general practice. With the small loads carried at that time no trouble from the lead lining was experienced.

Today, heavier linings are in use. It is necessary to use alloys, or harder substances to get results. When pure lead is used and pressure in excess of 400 pounds per square inch is on bearings, the lead will squeeze or flow. As there is only one direction that it can take it moves downward, shutting off the supply of oil between the journal and brass, causing brass to heat rapidly and invariably ruining journal. It would seem proper to use a high grade of metal for the lining of car brasses. A more general investigation of this subject would undoubtedly be the means of showing the importance of the proper mixtures for journal bearings in heavy capacity car service.

The linings in use on the European railroads are made from copper, tin and antimony and may be considered as having tin as a base. The general American practice is to use lead and antimony. Lead, antimony and tin or a lining with lead as a base. A dynamometer test of 65 to 80 cars with lead lining as against others made from babbitt, or of copper, tin, antimony and copper, tin, antimony and lead, would probably show some surprising results in an increase or decrease in journal friction, abrasion and fuel, thus showing the advantage of a tough homogeneous anti-friction car brass lining.

Questions bearing on the economics of journal bearings have not been fully proven. It is my opinion that a field is open for investigation in the matter of the comparative abrasive, wearing and frictional qualities of different mixtures of metal and their comparative wear on journals.

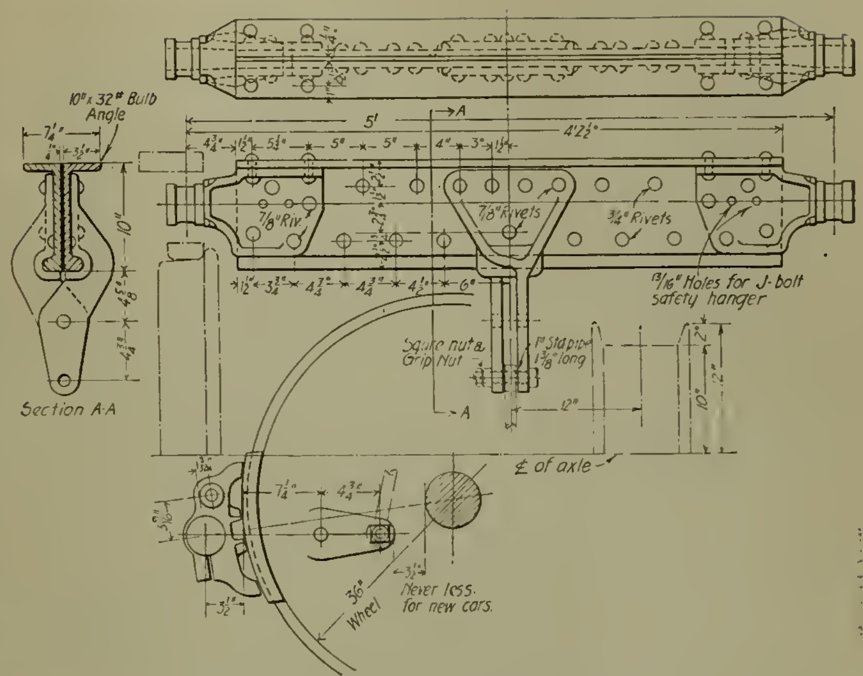
With a 70 car train we have 560 car journals. With a small decrease or increase of friction per journal, a

noticeable loss or saving on brasses, journals and fuel would be effected. There is one point that would have to be considered in a test as suggested and that is, that trains in question be equipped with good anti-friction side bearings of the same pattern in order that flange friction might not be confused with journal friction. The question would then be simplified as anti-friction side bearings bring down to a very low point the friction from flange contact. The resistance then to be determined could be taken as that from the journal, or the friction of rotation and friction between the wheel and rail, or rolling friction.

SPECIAL BRAKE BEAM FOR PASSENGER CARS.

The application of electric lighting dynamos to passenger cars has always involved trouble on account of interference between brake beam and belts. Whether the beams are outside or inside hung, the proposition is one that requires a constant watchfulness on the part of the mechanical department in the matter of designing apparatus to clear. It is possible, when the beams are outside hung, to arrange for the belt to pass on top of the beam if the drive is more than five feet from center of inside axle to center of dynamo, and if the drive is shorter than this the beam must pass between the belt.

On six-wheel trucks having inside hung beams or for four-wheel trucks arrangement, the limiting conditions seem to be that of clearance behind the beam, which makes it impossible to provide for a diamond truss construction of any kind. Having a 36″ wheel with shoes 1½″ thick when new, and tires 2½″ thick, it is safe to assume that the beam would advance 3″ closer to the center of the axle, when shoes and tires are worn to the condemning limit. This means that an initial clearance of 3½″ must be provided for between end of fulcrum and face of axle. The trussed type of passenger brake beam has never provided sufficient clearance for belts where the dynamo is suspended from the body of the car and the drive is 5′ 0″ or over. It is difficult to provide a beam of uniform section having sufficient strength if connections to brake rigging is made at the center, and yet, if

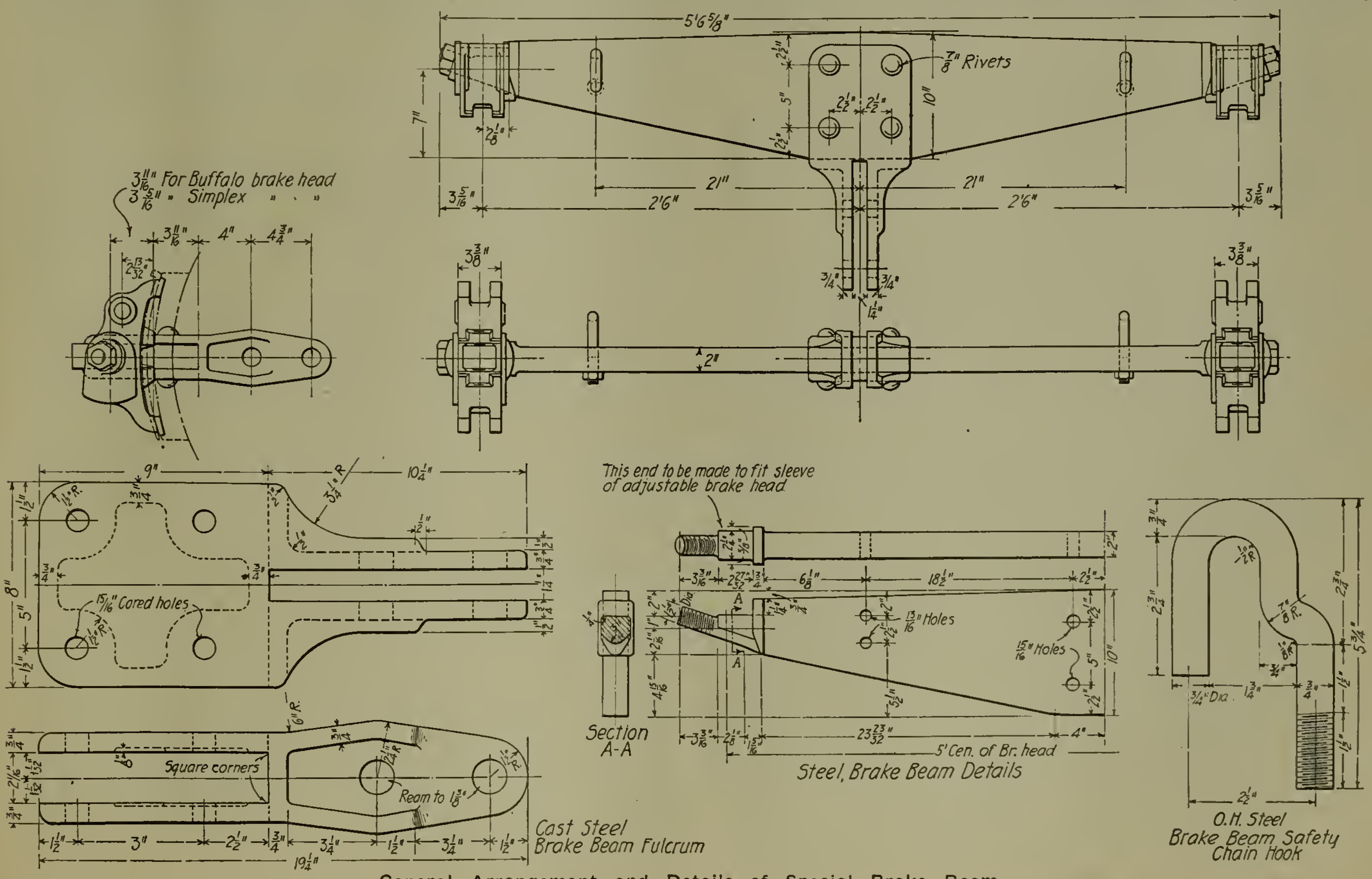


Special Brake Beam, 25 Ton Car.

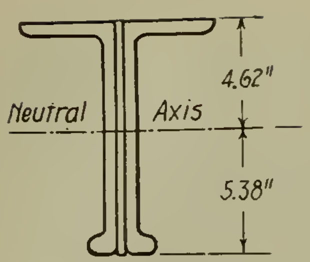
inside hung beams have been provided, it is obviously a mistake to provide an equalizing lever in order to make connection to the beams near the brake heads and in this way reduce the section necessary to carry the load.

The combination of two 10″ 32-pound bulb angles with a ¼″x10″ web plate is now in use on a northern road as a brake beam. This compound section illustrated herewith covers the lightest construction obtainable for cars fitted with six-wheel trucks having 5″x9″ axles. The weight of car carried on this style of truck has reached 84 tons in some designs of passenger equipment now operating in this country and it means that about 28,000 pounds pressure per beam is obtained at 60 pounds cylinder pressure, or practically 49,000 pounds for an emergency application.

This road also uses the forged brake beam, as it is easy to make and having dies to fit the various brake heads on the market, the sleeves are changed, a separate design of casting



General Arrangement and Details of Special Brake Beam.



2- Bulb Angles
10" @ 32 lbs. foot
1-Plate - 10"x $\frac{1}{4}$"

Moment of Compound Section
$$\begin{cases} 2\text{-}L^s = 2 \times 116 = 232.00 \\ \text{Plate} \quad = \underline{20.83} \\ I = 252.83 \end{cases}$$

Bending Moment at Center
$$\begin{cases} M = \frac{S\,I}{c} = \frac{16000 \times 252.83}{5.38} \\ = \frac{4.045.280}{5.38} \\ = 751.910 \end{cases}$$

$$\frac{P\,l}{4} + \frac{W_2\,l}{8} = M = 751.910$$

$$\frac{60\,P}{4} + \frac{350 \times 60}{8} = 751.910 \qquad 15\,P = 749.285$$
$$P = 49.952 \text{ lbs.}$$

Load at center with extreme fibre stress 16.000 lbs.

Method of Computing Strength of Special Brake Beams.

being required for each make. Some of these forged beams having a 2"x10" cross section, and some of the regular trussed beams were tested recently by the mechanical department of this road to find out how strong the trussed beams now in service were. One of these trussed beams was tested up to 75,000 pounds, at which point the sleeve broke. The trussed beam was supported on 60-inch centers with the load applied at the fulcrum hole. The compression member was a 3", 9-pound channel, the tension member a rod 1½" diameter (30% carbon), the weight of the beam was 160¼ pounds and the depth of strut 14 inches. The results of the tests are as follows:

Load	Total Deflection — Trussed Beam	Total Deflection — Forged Beam
20,000 lbs.	.060"	.055"
30,000 lbs.	.102"	.085"
40,000 lbs.	.150"	.118"
50,000 lbs.	.157"	.155"
60,000 lbs.	.242"	.195"

Basing calculations on a car weighing 160,000 pounds and 105 pounds cylinder pressure the fibre stress in the forged beam is 21,002 pounds. Under the same conditions the fibre stress in the bulb angle or combination beams is 14,780 pounds per square inch.

Narrow Gauge Electric Locomotive

An interesting type of electric locomotive has been constructed for service at the mines of the Braden Copper Company in Chile, by the General Electric Co. It is a 25-ton, double truck machine for 30-in. gauge, and has an overall height of only 7½ ft. The four drawing motors are each rated at 45 h.-p., 250 volts, multiple unit control, and automatic air brakes are also included in the equipment. It is probable that this locomotive is the heaviest with the narrowest gauge and the lowest overall height of any machine of this type ever built.

THE RESUMPTION IN BUSINESS

The basis for a general resumption of active business is present in the condition of retail stocks, which are low, and in the great wealth of the agricultural classes through high prices realized and being realized for their products. What is needed is a great buying movement. This must come initially from the railroads. Railroad buying has not started in volume, but there are evidences of coming activity in this direction both in rails and equipment. Business in steel, textile fabrics, food products, leather and rubber show improvement through increasing orders, with some price tendencies upward. Sentiment is bettering, but betterment is more than sentimental; it is getting to be actual. The stimulation of foreign purchases is helping domestic trade. In copper there is a lull in buying, but those in touch with the situation look for resumption of activity soon and further strengthening of prices. There is no let-up in consumption of copper in the fighting countries, and it is certain that there will be a steady absorption of metal for a long time to come, on armaments. The stock market is giving a good account of itself. For investment, there has probably not been for years such an opportunity to purchase good securities at low prices.

New Books

MACHINE DESIGN, CONSTRUCTION AND DRAWING. By Henry J. Spooner.. Cloth, 6x9 inches, 746 pages, illustrated with over 1600 figures. Published by Longmans, Green & Co., 4th Avenue and 30th Street, New York. Price $3.50.

The author is professor of mechanical and electrical engineering at the Polytechnic School of Engineering, London, England, and while the work contains some references to English practice, as a whole it covers its subject very well and completely. The first five chapters are devoted to drawing and the subject is treated in a manner that the beginner will find it easy to learn. The remaining chapters deal with matters relating to design and construction, and are illustrated with many details of machine parts. The following titles of some of the chapters suggest the scope of the book: "Riveted Joints," "Bolts and Nuts," "Bearings, Journals and Hangers," "Pistons and Piston Rods," "Engine Excentrics." One of the most complete chapters is that on "Materials Used in the Construction of Machines." Each chapter is concluded with a set of questions and suggestive drawing exercises. While the book is intended to be helpful in teaching work, it contains interesting and valuable matter for the man in the drafting room and shop. This is the third edition of the book and it has been carefully revised.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Proceedings of the forty-seventh annual convention. Cloth, two volumes, 6x9 inches, 1045 pages, illustrated. Published by the secretary, J. W. Taylor, 1112 Karpen building, Chicago, Ill.

Volume two of these proceedings contains a report of the committee on electric headlights. This book of 380 pages is a very complete treatise on the subject, for, in addition to the committee report and the ensuing discussion, it contains a summary of state headlight laws, comments on other tests and a great deal of valuable data pertaining to the subject. The association is to be congratulated on getting this matter together in one volume. Volume one contains the balance of the report of the convention which was held at Atlantic City on June 15, 16 and 17, 1914.

MASTER CAR BUILDERS' ASSOCIATION. Proceedings of the forty-eighth annual convention. Cloth, two volumes, 6x9 inches, 968 pages, illustrated. Published by the secretary, J. W. Taylor, 1112 Karpen building, Chicago, Ill.

Following the practice of last year, the standards, recommended practice and code of rules of the association are given together in volume two, while the proceedings of the convention held at Atlantic City last summer are incorporated in volume one. Among the subjects covered by committee reports are: Brake shoe and brake beam equipment; car construction, trucks and wheels; coupler and draft equipment; damage caused by unloading machines; overhead inspection of box cars; tank cars; train brakes, signals and lighting.

THE MECHANICAL WORLD ELECTRICAL POCKET BOOK. Cloth, 3x5 inches. Published by N. Remington Co., Baltimore, Md. Price, 50 cents. This publication comes out this year with about one fourth of the matter contained within its covers re-written and brought down to date. The amount of helpful information contained is surprising, considering the price. It contains a large collection of electrical engineering notes, tables, rules and data.

THE MECHANICAL WORLD POCKET BOOK. Cloth, 3x5 inches. Published by N. Remington & Co., Baltimore, Md. Price, 50 cents. This collection of mechanical notes, tables and data is brought down to date this year by new sections on structural iron and steel work, strength of flat plates, limit gauges, cost of power, proportions of Tee slots and Morse tapers. Some of the tables have been extended and others revised.

Personals

J. P. DOLAN succeeds R. A. Billingham as master mechanic of the *Apalachicola Northern* with office at Port St. Joe, Fla.

D. E. BARTON succeeds E. E. Machovec as master mechanic of the *Atchison, Topeka & Santa Fe* at Argentine, Kan.

T. C. O'BRIEN has been appointed general foreman of the *Baltimore & Ohio Southwestern*, with offices at Lima, O.

MARTIN MURPHY has been appointed general boiler inspector of the *Baltimore & Ohio Southwestern*, with office at Cincinnati, O.

A. E. MCMILLAN has been promoted to master mechanic of the *Baltimore & Ohio Southwestern* at Washington, Ind.

W. H. KELLAR has been appointed assistant master mechanic of the *Baltimore & Ohio Southwestern*, with office at Cincinnati, O.

WILLIAM MALTHANER has been appointed master mechanic of the Newark division of the *Baltimore & Ohio*, with office at Newark, O.

E. S. FOSTER has been appointed general foreman of the *Bangor & Aroostook* at Oakfield, Me.

W. C. DEAN has been appointed traveling engineer of the *Bangor & Aroostook*, with headquarters at Derby, Me., succeeding E. S. Foster.

G. WHITLEY has been promoted to assistant superintendent of motive power of the eastern lines of the *Canadian Pacific*, with headquarters at Montreal, Que.

C. KYLE has been appointed master mechanic of the Atlantic division of the *Canadian Pacific*, with headquarters at St. Johns, N. B.

W. A. BARNES has been appointed road foreman of engines of the *Chicago, Burlington & Quincy* at Ottumwa, Ia.

C. RAUSCH has been appointed master car painter of the *Chicago, Burlington & Quincy* at Aurora, Ill., succeeding J. D. Hall.

W. P. JAMES succeeds Charles Ray as car foreman of the *Chicago, Milwaukee & St. Paul* (Puget Sound lines) at Tacoma, Wash.

F. J. ANDERSON has been appointed traveling engineer of the *Chicago, St. Paul, Minneapolis & Omaha* at Sioux City, Ia.

J. J. REID succeeds William Malthaner as master mechanic of the *Delaware & Hudson* at Oneonta, N. Y.

G. S. GRAHAM succeeds J. J. Reid as master mechanic of the *Delaware & Hudson* at Carbondale, Pa.

B. TRENTMAN succeeds E. Jones as foreman of car repairs of the *Delaware & Hudson* at Oneonta, N. Y.

V. H. MCGINNIS has been appointed traveling engineer of the *Denver & Rio Grande* vice A. G. Titus. His office is at Grand Junction, Colo.

J. T. HOLT succeeds F. Constantine as locomotive foreman of the *Great Northern* at Sandstone, Minn.

WIRT PARKER succeeds F. Heins as master mechanic of the *Gulf & Sabine River*, with office at Fullerton, La.

E. J. BRYANT has been promoted to master mechanic of the *International & Great Northern*, with office at Mart, Tex., vice W. G. Hall.

S. T. ARMSTRONG has been appointed master mechanic of the *International & Great Northern* at Palestine, Tex., vice T. Windle, resigned.

P. ROQUEMORE has been appointed mechanical engineer of the *International & Great Northern*, with headquarters at Palestine, Tex.

NORMAN BELL has been appointed master mechanic of the *Illinois Central* at Waterloo, Ia., succeeding F. W. Taylor.

H. H. BUCKMAN succeeds W. E. Myers as master mechanic of the *Interstate Public Service Co.*, with office at Greenwood, Ind.

W. P. MCDEVITT has been appointed master mechanic of the *Kentucky & Indiana Terminal*, with office at Louisville, Ky. He succeeds John F. Newhouse.

A. BRAND *succeeds* B. B. Carge as master mechanic of the *Lake Terminal*, with headquarters at Lorain, O.

J. PICKLEY succeeds J. Keller as road foreman of engines of the *Lehigh Valley*, with headquarters at Wilkes Barre, Pa.

H. SELFRIDGE has been appointed master mechanic of the *Nevada Northern*, with headquarters at East Ely, Nev.

OMAR BLOOD has been appointed general foreman, car department, of the *New York Central* at Sandusky, O., vice R. A. Fitz, transferred.

F. J. BARRY has been appointed master mechanic of the *New York, Ontario & Western* at Childs (Mayfield Yard), Pa., vice W. H. Kinney, resigned. Matters relative to steam heat and lighting have been placed in charge of A. Kipp, general car inspector.

S. P. SEIFERT has been appointed supervisor of the car department of the *Norfolk & Western*, with office at Roanoke, Va.

J. E. MOHANEY succeeds W. J. Luke as general storekeeper of the *Norfolk Southern*, with headquarters at Norfolk, Va.

J. K. BRASSILL has been appointed superintendent of motive power of the *Northwestern Pacific*, with headquarters at Tiburon, Cal.

R. H. FLYNN, general foreman of the *Pennsylvania Lines West*, has been transferred from Louisville, Ky., to Bradford, O.

T. B. FARRINGTON succeeds C. W. Kinnear as general foreman of the *Pennsylvania* at Bradford, O.

P. J. NEISKINS succeeds C. Sonburg as general foreman of the *Pere Marquette* at Chicago, Ill.

C. TAYLOR succeeds P. G. Nelson as general foreman, car department, of the *San Antonio, Uvalde & Gulf*, with headquarters at Pleasanton, Tex.

K. H. MARTIN has been appointed general equipment inspector of the *Southern*, with headquarters at Washington, D. C.

L. ATWELL has been appointed general foreman of the *Southern* at Selma, Ala., succeeding T. S. Krahenbuhl.

H. G. STUBBS has been appointed general foreman of the *Southern* at Macon, Ga., succeeding W. P. McDevitt.

W. C. BUREL succeeds H. Selfridge as general foreman of the *Oregon Short Line* at Salt Lake City, Utah.

WILLIAM H. MURRAY has been appointed foreman of the *Oregon Short Line* at Montpelier, Ida., succeeding W. C. Burel.

E. F. NEEDHAM, superintendent of the locomotive and car departments of the *Wabash*, has had his headquarters moved from Springfield, Ill., to Decatur, Ill.

WALTER ALEXANDER, who has just been appointed a member of the railroad commission of the State of Wisconsin, has for the past thirteen years held positions as assistant district master mechanic and district master mechanic at Minneapolis and Milwaukee with the *Chicago, Milwaukee & St. Paul Ry.* The law creating the railroad commission of Wisconsin requires that one member be familiar with transportation conditions and problems and it was Governor Philipp's idea that a man who has had practical experience in railroad operation as well as a technical training as a mechanical engineer would be best suited for the position. Mr. Alexander was born in Glasgow, Scotland, in 1872, and came to Milwaukee in 1873. After receiving a common school education he served an apprenticeship as a machinist and draftsman with the Chicago, Milwaukee & St. Paul, and was also employed as a fireman with that company. While so employed he prepared himself for college and entered the University of Wisconsin in 1893, graduating from the mechanical engineering course in 1897. He received a second degree in engineering the follow-

Walter Alexander.

ing year and after three years instructional work in engineering at the University of Wisconsin, one at Armour Institute and one at the University of Missouri, he returned to railroad service as assistant district master mechanic at Minneapolis. Two years later he was transferred to Milwaukee to a similar position and later on was made district master mechanic, which position he has held up to the present time. As district master mechanic he has had charge of the motive power work on lines east of the Mississippi river.

OBITUARY

G. M. Bunting, general car foreman of the *Pennsylvania* at Cleveland, O., died on January 6, and was buried in Lakeview cemetery, Cleveland, on January 8. He was born on September 4, 1862, and was 52 years of age. He had been in the employ of the Pennsylvania railroad for thirty-two years, having been general foreman of the car department for the past twenty-three years. Mr. Bunting had been a member of the Chief Joint Car Inspectors and Car Foremen's Association since 1899 and the funeral was attended by a number of the members. The following resolution on his death was formed by a committee composed of W. D. Mooney, George Lynch and William Westall:

"It having pleased the Divine Providence to remove from our midst Brother George M. Bunting, be it resolved in the taking from us of Brother Bunting this association loses a valued member, who, by his honest worth, integrity of character and genial manner, endeared himself to all.

"Be it further resolved that we extend to his beloved wife and children our heartfelt sympathy in the bitter loss they have sustained, and be it further resolved that a copy of these resolutions be forwarded to the bereaved family, to the *Railway Master Mechanic*, and spread upon the minutes of the next meeting of this association."

G. M. Bunting.

New Literature

The General Electric Co., Schnectady, N. Y., has issued a bulletin descriptive of an oil-testing set recently developed by this company. It is used for testing the dielectric strength of oil for use in high-tension oil-insulated apparatus.

* * *

Forging Talk number 6 of the National Machinery Co., Tiffin, O., takes up the "friction-slip" type of fly wheel recently adopted for use on National forging machine. The construction is such as to allow the wheel to slip if the machine becomes stalled, thus protecting it from abnormal strain.

* * *

"Centrifugal Pumps" is the title of a 64-page bulletin just issued by the Terry Steam Turbine Co., Hartford, Conn., giving details and data on various turbo-pump applications. The principles of operation and construction of the centrifugal pump are clearly explained, as are the details of the steam turbines used for driving them. Because of the wide latitude of speed possible with the turbine—the unit occupies a much smaller space than would be required for a pump performing the same duty but driven by a reciprocating engine.

* * *

The Armstrong Cork & Insulation Co., Pittsburgh, Pa., has issued a booklet the title of which is "At War with Heat." It deals with the various types of "Nonpareil" insulation.

The Selling Side

C. B. McElhany, assistant general manager of sales of the Cambria Steel Company, has been appointed general manager of Sales, succeeding J. Leonard Replogle, who has resigned to enter the service of the American Vanadium Company.

James S. Llewellyn has been elected secretary, and Paul Llewellyn treasurer of the Chicago Malleable Castings Company. James S. Llewellyn will continue to hold the office of works manager at the West Pullman works.

Thomas S. Grubbs, auditor and secretary of the Westinghouse Machine Co., has been elected secretary and assistant treasurer of the Union Switch & Signal Co., and George F. White, of the Westinghouse Machine Co., has been elected assistant secretary of the Union Switch & Signal Co.

H. Bortin, formerly engineer in charge of valuation department of Union Pacific R. R. for four years, and member of its valuation committee; lately assistant to general secretary of Presidents' Conference Committee on Federal Valuation of the Railroads, announces his entry into private practice as consulting valuation engineer, with office at 149 Broadway, New York city.

Standard Union Concrete Equipment Co. has been incorporated to manufacture machinery to make concrete. The incorporators are Louis A. Rice, Brooklyn; E. M. Kolstad, New York; Walter R. Darby, Westfield, N. J.

The Lehigh & New England has ordered 500 tone of structural steel for its new shops at Pen Argyl, Pa., from the American Bridge Co.

The Schaefer Equipment Co., manufacturers of the Schaefer truck lever connection and other railway specialties, has removed to Suite 2138 Oliver building, Pittsburgh, Pa.

The Spencer Otis Co., Railway Exchange building, Chicago, has now been incorporated with a capital stock of $75,000. Edward A. Grams, Abner J. Stillwell and O. Guernsey Orcutt are the incorporators.

The Shippers Refrigerating Car Co., Chicago, has been incorporated with a capital stock of $500,000. The incorporators are Henry H. Phillips, I. J. Horne and Oscar Anderson. The company is represented by Pain & Hurd, Rookery building.

The Bucyrus Company, The Western Wheeled Scraper Company and The General Equipment Company have recently opened a joint office at 715 Commercial Trust building, Philadelphia, Pa. The office is in charge of E. G. Lewis.

The Railway Safety Appliance Company has been incorporated in Delaware by J. E. Hart, George Clare and J. D. Gray, of Chicago. The concern controls patents on railway safety devices, and has a capitalization of $1,000,000.

The O. H. Davidson Equipment Company, Denver Colo., has been appointed western representative for the Electric Controller & Manufacturing Company, of Clevelaand, Ohio.

The Daniels Safety Device Company has moved its offices from 327 South La Salle street to the Continental & Commercial National Bank building, 208 South La Salle street, Chicago.

The Liberty Railway Products Company, Chicago, Ill., has been incorporated with $22,000 capital stock to manufacture railway supplies. Geo. S. Pines, Albert G. Rosenbaum, Benjamin Mesirow, 111 West Monroe street, are the incorporators.

William H. Kinney, formerly master mechanic of the New York, Ontario & Western at Carbondale, Pa., has entered the railroad sales department of the Dearborn Chemical Company, Chicago. He will have his headquarters at the company's New York office.

J. A. McCulloch, engineer of the National Tube Company, was recently elected chairman of the mechanical section of the Engineers' Society of Western Pennsylvania.

W. S. Ottinger, district sales manager of the Cambria Steel Company, has been appointed assistant general manager of sales, to succeed C. B. McElhany, who has been appointed general manager of sales. Mr. Ottinger will be succeeded as district sales manager by F. J. Krouse. Albert S. Johnson will become assistant district sales manager, succeeding Mr. Krouse.

L. H. Mesker has recently become associated with the sales department of the Kearney & Trecker Co., Milwaukee, Wis., and will represent that company in Ohio after February 1.

W. P. Mellon has been appointed railway sales manager of the southeastern district of the Flint Varnish Works, with headquarters in New York. Mr. Mellen is widely known throughout the country among operating, purchasing and mechanical officials. He is conspicuous as an exponent of high grade salesmanship, possesses a rare knowledge of varnishes and paints and enjoys a personal popularity among those with whom he comes in contact, enviable indeed. While his prestige is undimmed by his absence of several years, he returns to the fraternity with the expressed good wishes of many prominent men interested in railroad progress. He will do his share of that we are certain.

M. A. Sherritt, for several years associated with Manning, Maxwell & Moore, Inc., New York, as manager of the company's Philadelphia branch, resigned this position on January 25 to become vice-president and general manager of Sherritt & Stoer Co., Inc., dealers in machine tools and railway and machine shop equipment. The company will occupy its new offices in the Finance building, Philadelphia, on February 1.

Samuel Higgins, formerly general manager of the New York, New Haven & Hartford, has been elected president of the Standard Heat & Ventilation Co., of New York and Chicago.

N. D. Carpenter, district manager of sales for the Carnegie Steel Co., at Detroit, Mich., with headquarters in the Ford building, has resigned, effective Feb. 1, 1915, and will be succeeded by Frank E. Spencer, formerly connected with the Pittsburgh sales office of the same company.

Lyndon F. Wilson, vice-president of the Railway List Co., has resigned to become vice-president of the Bird-Archer Co., of New York, effective April 1, 1915.

Mr. Wilson was born at Rush Lake, Wis., November 4, 1883, and was educated at Ripon College, Lawrence University, and the University of Wisconsin. Before entering college he was engaged as an operator in the office of his father on the Chicago, Milwaukee & St. Paul, and later, after considerable machine shop and power plant experience, he became an engineer in the service of the Interior Department of the United States Government. After one year in the service he joined the engineering department of the Western Electric Company, where he was engaged until the fall of 1908 when he became mechanical department editor of the

Lyndon F. Wilson.

Railway Review. In March, 1909, he came to the Railway List Co., as editor of the *Railway Master Mechanic* and later became editorial director of the publications of the company, namely, *The Monthly Official Railway List, Railway Engineering and Maintenance of Way, and Railway Master Mechanic.* In September, 1913, he was made a vice-president of the company. Mr. Wilson has a pleasing and forceful way about him, a loyal disposition and the ability to accomplish what he undertakes. He is well acquainted with the railway and supply fields, and his former associates, in wishing him the best of good fortune, predict abundant success in his new work. After April 1st Mr. Wilson will be located in the Chicago office of the Bird-Archer Company.

The Marion Steam Shovel Co., Marion, O., has elected the following officers for the coming year: President and general manager, Geo. W. King; general superintendent, B. P. Sweeny; vice-president and treasurer, Frank A. Huber; secretary and director of purchases, Harry C. Barnhart; vice-president and assistant general manager, Charles B. King.

R. M. Nicholson has been placed in charge of the advertising of the Stark Rolling Mill Company, Canton, Ohio.

H. H. Seabrook, formerly district manager of the Westinghouse Electric & Manufacturing Company in Baltimore, has been appointed district manager of the company at Philadelphia, succeeding J. J. Gibson, who has become manager of the tool and supply department at East Pittsburgh.

The William B. Pollock Co., Youngstown, O., has re-elected the following officers: President, Porter Pollock; vice-president and general manager, Charles W. McClure; secretary and treasurer, William G. Wilson; general superintendent, William W. McKelvey.

J. A. McFarland has recently been appointed southwestern district manager of the Bird-Archer Company, ith headquarters in the Frisco Building, St. Louis, Mo. Mr. McFarland was born on October 23, 1880, at Mendota, Ill. After finishing his common school education he entered the University of Illinois from which he graduated in a chemical course in 1903. He began railway work in May, 1903, being connected with the chemical department of the Atchison, Topeka & Santa Fe at Topeka, Kan., and left this road on January 1, 1904, to become assistant in the testing department of the Chicago & Northwestern. In February, 1905, he became chief chemist of the Missouri Pacific, remaining in this position until May, 1909, when he took charge of the St. Louis office of the Dearborn Chemical Co., looking after their railroad business in that territory. In July, 1911, he left that company to become chemist and engineer of tests of the Frisco system, and later became connected with the Standard Railway Equipment Co., where he remained until his recent appointment.

J. A. McFarland.

Earl F. Scott, has been appointed representative of the Terry Steam Turbine Co., for the state of Georgia, with offices at 702 Candler building, Atlanta, Ga.

David A. Wright, who for several years past has been connected with the Yale & Towne Manufacturing Co., New York, as district manager in the West, has opened an office for himself as manufacturers' agent at 140 South Dearborn street, Chicago, Ill. He will specialize on labor saving and pneumatic machinery, cranes, etc.

The John Seaton Foundry Co. and the Locomotive Finished Material Co., Atchison, Kan., have consolidated, and will continue the business of both companies under the name of the Locomotive Finished Material Co. The directors of the consolidated companies are: John C. Seaton, H. E. Muchnic, Clive Hastings, W. C. Ferguson and G. L. Seaton.

Fire badly damaged the insulated wire department of the John A. Roebling's Sons Co. at Trenton, N. J., recently. The loss is estimated at $1,000,000.

The Asbestos Protected Metal Co. has moved its general offices, including the executive, accounting, sales and engineering staffs, from the Beaver Falls, Pa., plant to the First National Bank building, Pittsburgh. The manufacturing operations of the company will continue as heretofore, at Beaver Falls, Pa., and at Waltham, Mass.

The Southern Wheel Co., successor to the Decatur Car Wheel Works, Birmingham, plans extensive improvements to its plant which will enable it to produce railroad frogs and switches, as well as forgings and castings.

The Kennedy-Stroh Corporation, of Pittsburgh, with a capitalization of approximately $2,500,000, has taken over all rights, processes and factories of the Kennedy Mfg. & Engineering Co., of New York, the Stroh Steel Hardening Process Co., the Lawrence Steel Casting Co., and the Best Mfg. Co., of Pittsburgh.

Fred O. Paige, vice-president of The Bird-Archer Co., with office at New York, has resigned.

William C. Reitz, treasurer of the Pittsburgh Steel Co. and the Pittsburgh Steel Products Co., Pittsburgh, has resigned as treasurer of the former concern to devote all his time to the interests of the latter, having also been elected secretary of the Pittsburgh Steel Products Co.

The Car Lighting Co. has been incorporated with $100,000 capital stock in New York. It will deal in railway equipment. The incorporators are W. H. Black, L. W. Young, W. P. Horn, 132 Madison avenue.

The Bethlehem Steel Co. has let contract for nine one and two-story buildings to be erected at New Castle, Pa. This plant will be used as an export depot.

Considerable damage resulted from an explosion Dec. 26 at the plant of the Boston Gear Works, at Norfolk Downs, Mass.

C. P. Howard, formerly a member of the firm of Berry, Howard & Roberts, announces the opening of an office, 1603-4 Transportation building, Chicago, as consulting engineer.

The Canadian Car & Foundry Co., Ltd., of Canada, will open an office in London with the intention of broadening out its trade in other British possessions, mainly Australia, South Africa, India and the Far East.

The Chadeloid Chemical Co., of New York, is entitled to a preliminary injunction against the Wilson Remover Co., according to a decision of the United States district court for the southern district of New York. The case is one of some importance in the paint and varnish remover trade.

J. Rogers Flannery, chairman of the Pittsburgh Foreign Trade Commission, was a speaker at the chamber of commerce dinner in the Fort Pitt Hotel, Pittsburgh, on January 13.

Orders for lathes from Europe continue to come in, the R. K. LeBlond Machine Tool Co., of Cincinnati, having received a contract for 200 such machine tools for prompt delivery.

The Trenton Smelting & Refining Co., Trenton, N. J., has been incorporated for $100,000. The incorporators are Charles H. Cunningham, John H. Hamilton and Dennis S. Bresnahan.

OBITUARY

James F. McElroy, president of the Consolidated Car Heating Company, Albany, N. Y., died at Laconia, N. H., on February 10, at the age of 63 years.

Samuel D. Kinney, superintendent of the Baldwin Locomotive Works, at Eddystone, Pa., died at his home in Philadelphia, January 22, aged 51 years.

Charles S. Price, for 18 years general manager of the Cambria Steel Co., and for two years its president, died unexpectedly on January 10 at his home near Johnstown, Pa., from what is believed to be heart failure. He had been ill for some time, but was confined to his home only a few days prior to his demise.

Barton Sewell, president of the Braden Copper Co. and vice president of the American Smelting & Refining Co., died Jan. 7 at his home in New York.

Leonard W. Kent, formerly eastern sales agent of The P. & M. Company, with offices in New York, died suddenly at his home in Westwood, N. J., on January 24.

C. A. Thompson, formerly superintendent of motive power of the *Central of New Jersey*, died at Jamaica, N. Y., on January 4, at the age of 81.

T. L. Chapman, at one time superintendent of motive power of the *Chesapeake & Ohio*, died at Caldwell, N. J., on December 30, at the age of 71.

Publishers' Announcement

From the homogeneous to the heterogeneous, from the simple to the complex, from the primitive man living alone to modern man living with due regard to others as well as himself, from savagery to civilized society, a long step from prehistoric man to the present day.

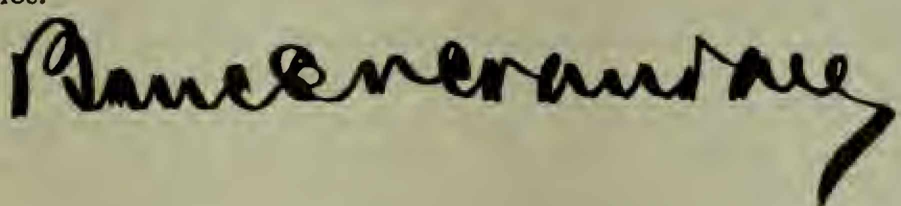
Only yesterday in the limitless measurement of time was the inception of railroading and today is its development and the completing of its growth. This rapid growth of an intricate gigantic industry, almost within the lifetime of one man, has meant the meeting and solving of more problems than have ever been given to mankind since primitive man turned his back upon his animal ancestors and set his face toward the wonderful civilization which we enjoy today.

There are many units in this forward march of the great transportation systems. A small unit, still having its part to play, is the railway publication. One of the smallest of these is RAILWAY MASTER MECHANIC. Its size does not minimize its importance. It occupies a special position in the railway field and is performing a work not attempted by any other journal. It becomes then a necessary link in the chain.

The function of a railway publication of the character of this journal should be to furnish a medium for the intelligent discussion of the problems confronting the railway man and the solution to the problems as given by the railway supply man.

RAILWAY MASTER MECHANIC is not a paper exclusively for the railway man, nor exclusively for the railway supply man. It is for both of them and equally so.

Taking a broad view of the field occupied by this journal, without bias and without prejudice, this publication will be edited with the idea of "the greatest good to the greatest number" in the field of railway motive power, cars, equipment, shops, machinery and supplies.



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In remitting, make all checks payable to Bruce V. Crandall.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

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CONTENTS.

Mechanical Men and the Public

The work of the mechanical department of railways is not such as to bring it in close touch with the road's patrons. On times gone by the public, through its legislators, did not take the deep interest in railways that it has in recent years and for these reasons railway mechanical officials often considered themselves quite widely separated from the public at large.

The viewpoint of the railway man is changing in this respect, however. He is seeing the advantage in getting before the public and getting it acquainted with the true conditions which face the country's second greatest industry. A very good illustration of this is an address recently delivered before the Rotary Club of Shreveport, La., by W. H. Sagstetter, master mechanic of the Kansas City Southern at that point. This address, while it contains some interesting thoughts for railway men, was delivered before a representative public body and did a great deal of good in promoting a better knowledge and understanding of railway mechanical matters among those who heard it.

Such addresses do much to give the public a better knowledge of our railways and their needs, and if railway men take full advantage of their opportunities they can do much to create a better sentiment.

Standardization of Shop Methods

The growth of standards in American railway practice has been steady and there is every reason to believe that it will continue. In the mechanical department the Master Mechanics' and Master Car Builders' Associations have done much to standardize rolling stock and equipment, and in this work our government is contributing its share also. Much necessary work still remains to be done by these associations, however, as for instance, the standard box car.

The standardization of methods in railway shops, on the other hand, is a field in which but little work has been done. Whether or not good may be accomplished by work in this line is a question at least well worthy of debate. In an article in the February issue of *The Engineering Magazine,* Ernest Cordeal states that "the lack of efficiency in the performance of the multitudinous tasks included under the heads of maintenance of equipment is due in a great part to a lack of standard methods wherefrom it may be definitely known just how each one of the details should be handled." He advocates especially that each road standardize its own shop methods, by means of a careful study of the various methods in use at the several shops, but he does not dwell long on the subject of standardization of the shop methods throughout the country. It is quite safe to say that the consummation of the latter idea will not take place at an early date.

It is true that methods of doing a certain class of work in different shops on the same system often vary considerably, and frequently it is accounted for by local conditions. Whether standards of shop methods for an entire

system can be established with success is possibly a debatable question also. Standards would necessarily be subject to change more or less frequently, due to changing conditions, the introduction of labor saving machinery, etc., and this might offset the benefits derived. On the other hand the central tool room plan and the manufacture of certain parts at a central shop has proved successful and is a step in this direction. Undoubtedly frequent conferences between the superintendents of the shops of a system, while it would not result in hard, fixed standards, would benefit all concerned for the real object of the shop official is to do good work at as low a cost as possible.

Steel Ends for Freight Cars

Steel has gradually been supplanting wood in railway freight and passenger cars, and the value of its use in future car construction can scarcely be questioned. One particular development along this line, which has come into prominence during the past few years, has been the steel end for freight cars. The ends of box cars are subject to heavy strains and shocks, of which there is plenty of evidence in any repair yard in the way of broken sheathing and cars with the entire end broken out. The placing of a strong bulwark to take the shocks, due to shifting loads and other like conditions, is attained by the use of the steel end, and it appears that it has been very successful in preventing damage to the car body at this point.

Although the steel end is being applied to both new and old cars, it has particularly found favor for application to old wooden box cars. However, it must be remembered that even the application of a steel end to an old car is not an insurance against damage, for if the body and corner posts are so far gone that they will not stand their share of the strain, the end is lacking the proper backing and cannot do its work. The end must be fastened securely, and the car framing must at least be in fair condition. Otherwise it scarcely has a just opportunity to prove its worth.

Possibly the only objection to the steel end in use has been that it sweats somewhat, especially when loaded with grain. This objection is taken care of on some roads by placing a bulk-head inside the car.

Railway mechanical men, as a whole, are very favorable toward the steel end. Still its use has not been extended as rapidly as its merit deserves. Its cost, of course, is somewhat higher than the ordinary end, and conditions have been such during the past two or three years that repairs had to be made with the least expenditure possible. Some railway officials contend also that the price asked for the ends is too high.

The steel end, even if the initial investment is perhaps higher, will add to the life of wooden box cars very materially. The life of the box car is but short at best, and it is gratifying to note that the steel end is gradually finding favor.

CORRESPONDENCE

Editor, *Railway Master Mechanic:*

I think that the time is here when associations such as the St. Louis Car Foremen's association and others should be organized at all cities where interchange of cars takes place, and they should in turn be a branch of a general association which would be made up of say five members from each city. Any recommendations that a branch had to make could be made to the general association through their representatives. In this way all the recommendations would be included in one, from all points in the country. In other words the recommendations would be coming from every car man in the country, in a concrete form, and would greatly assist the Master Car Builders in their deliberations, by eliminating recommendations from so many individual organizations. I believe nearly everyone will agree that from the car men on the ground, should come the practical suggestions and recommendations.

I also believe that all railroad officials should insist that their men should be members of these organizations, and see that they are active members, and the officials themselves should attend the meetings whenever possible. The old saying: "United we stand, divided we fall," applies to all branches of business, and the car business is no exception. What hurts most of all is to have men with good ideas keeping their ideas to themselves, and fearing to express them for fear they will not meet with the approval of someone else. Association has a wonderful way of doing away with this as through it "bill" out in California, has met "Jim" up in New York, and feels a friendship, and a confidence that could never be created by correspondence or over the telephone.

W. P. Elliott, Foreman Car Dept.,
Wiggins Ferry Co., East St. Louis, Ill.

Editor, *Railway Master Mechanic:*

I noticed an article in the January, 1915, issue headed "A Substitute for Files for Air Brake Repair Work" by Frank J. Borer, Air Brake Foreman, Central Railroad of New Jersey.

While all railroads have a perfect right to manage air brake work to suit themselves and use any tool they see fit, I do not agree with Mr. Borer in his use of emery powder or emery paper in facing slide valves or slide valve seats of triple valves. These ingredients should never be used where an air tight fit is necessary, as emery of any kind will bed itself in the brass and as soon as the valve and seat come in contact with each other, cutting will begin.

Square files manufactured for the different size valves should be used for this purpose, furnished by the air brake company, as they will cut the seat perfectly even. In my experience of thirty years as an air brake repairman and inspector I find these files to be the most economical tool for this purpose and will last for years if properly taken care of.

In my regular monthly inspection on line of road, I find a good many triple valves with leaky slide valves which have recently been cleaned, oiled and tested. I have also made inspections in different railway shops where I was not known as an air brake man. I found in a good many places that when the triple valve is placed on the test rack and the slide valve leaks, a heavy grease is applied which will stop the leak while triple valve is on the test rack, but as soon as placed in service the grease will blow off or create undue friction on the slide valve and seat, thereby causing undesired quick action, clogged ports, etc. This slide valve then has to be removed and the work all done over again.

Air brake work not done properly is useless and each repairman should be supplied with the proper tools if good results are expected. It is very disappointing to see a brake stenciled as having been cleaned and oiled on a certain date and find it unfit for service three or four weeks after the date of cleaning, necessitating a duplication of the work.

A section foreman once employed his son to carry water to the section hands, but he was found inefficient and his father secured a place for him in the machine shop in order that he might learn the machinist trade. The boy was soon found inefficient there and was likewise transferred to the car shop in order that he might make a car repairer, but it was soon found that he would not make a success there and the car foreman remarked. "We'll make an air brake man of him." Now, if this boy could not make a water boy, machinist or car repairer he certainly could not make an air brake man. I merely mention this to illustrate that you can not expect good results of the air brake if you do not provide the proper tools for the repairman to work with.

It should be borne in mind that the air brake is the most important safety appliance of today and if not properly taken care of is worthless and will produce disastrous results.

In conclusion would like to say that any grinding compound whcih has a disastrous result on air brake material should not be used, and I would be glad to see an expression from other air brake men along this line.

F. von Bergen,
Chf. Air Brake Ins., N. C. & St. L. Ry., Nashville, Tenn.

The Locomotive Outlook in England

Looking around the British locomotive departments it does not appear that on the purely mechanical engineering side of railway work there are any particular signs of any new developments. The employment of superheating in locomotive practice is now becoming quite general, and the number of types of superheater being employed under service conditions holds out the promise that the last ounce of economy in coal consumption which can be attained by such a system will be achieved. If the Schmidt is still the type usually fitted, a large number of locomotives of the Great Central and other railways are using the Robinson, and the London & Southwestern and the Great Northern railways are now fitting superheaters designed in each case by their own locomotive engineers, which differ in many respects from older designs. A feature common to both these new superheaters is the employment of two independent heaters for the saturated and superheated steam. In detail, however, there are many differences between Great Northern and South Western practice, though a great advantage common to both is that the elements are interchangeable. Feed-water heating, in spite of the obvious soundness of the principle, has met with little favor at the hands of railway engineers.

Reference may be made to one or two of the locomotives put into service during the past year. One of these is the powerful 2-8-0 coal locomotive built in the Great Northern shops, which is designed to haul loads of 1,200 tons. On the Great Western Railway, which has always taken a prominent part in locomotive construction, a notable engine is the 2-8-0 tank, and another is the four-cylinder 4-6-0 type. The Swindon superheater and the top-feed arrangement are employed, and the working pressure is the somewhat high one of 225 pounds. On the London & Southwestern Railway the main work has been the addition of a number of 4-6-0 mixed traffic engines, which have done very useful service, and it is interesting to note that comparative tests are being carried out with the Robinson and Schmidt superheaters in this class, some members of which are also adapted for feed-water heating. The Northeastern Railway locomotive shops are making a new departure in the construction of some electric locomotives.

A special note to hand from the British Superheater Corporation points out that this company started the past year with a considerable number of orders on their books, and were compelled to increase their staff and accommodation in order to cope with the increasing business. Since the outbreak of the war a number of orders have been placed with them for the fitting of the Robinson locomotive superheater, although it was the original intention to install a rival system of German origin.

THE SITUATION IN BRIEF

Railway operating income for December, reduced to a per mile of line basis and compared with that for December, 1913, shows a decrease of $28, or 11.4 per cent, while operating income per mile for December, 1913, was 16.9 per cent less than for December, 1912. Total operating revenues per mile for December decreased 11.3 per cent as compared with December, 1913, operating expenses per mile decreased 11.3 per cent, while net operating revenue per mile decreased 11.4 per cent.

For the calendar year 1914 railway operating income per mile decreased $382, or 11.5 per cent, as compared with the calendar year 1913. The corresponding decrease in 1913, as compared with the calendar year 1912, was 6.6 per cent. Operating revenues per mile for the calendar year 1914 decreased 7.6 per cent as compared with 1913, operating expenses per mile decreased 7 per cent, while net operating revenue per mile decreased 9.3 per cent.

ST. LOUIS CAR FOREMEN'S ASS'N

At the November meeting of the Car Foremen's Association of St. Louis a motion prevailed that the further organization be considered, and that a committee be appointed to work along these lines. This committee reported at the next meeting, having drawn up a constitution and by laws, and submitted several recommendations which were adopted by the association. At the January meeting the following officers were elected:

President—J. C. Burke, F. C. D. Mo. Pac.; vice president—F. L. Meyer, F. C. I., Penn. R. R.; secretary—Miss P. M. Weigman, Sec. C. L. I. office; treasurer—W. S. Wright, F. C. D. E. St. L. & S.

The following were elected members of the Executive Committee:

H. A. Lightner, Gen'l F. C. D., I. C. R. R. (chairman); M. W. Halbert, C. L. I.; J. F. Fergeson, F. C. D., Southern Ry.; R. R. Lowell, Gen'l F. C. D., C., B. & Q. Ry.; C. D. Mitten Gen'l F. C. D., Armour Car Lines; R. W. Bowler, Trav. Gen'l Car Foreman, St. L. S.-W. Ry.; W. P. Elliott, F. C. D., Wiggins Ferry Co.

It is the intention to bring together all persons interested in matters pertaining to interchange of cars, and the handling of repairs, and to hold both night and day meetings so that the night inspectors and others may bring up points that may come to their minds and get the benefit of common discussion. This will be of much benefit as the majority of car foremen can attend the day meetings along with the night men.

The prospects of the association are very bright and being located as it is at one of the largest points of interchange in the world, there is much to be accomplished.

Machine Forging Work, C. & N.-W. Ry.

Some Examples of Machine Processes at the Chicago Shops of the C. & N.-W. Ry. Which Cut Down Labor Cost

By T. E. Williams, Master Blacksmith

The principal problem confronting the railway blacksmith foreman today is how, without a large increase in payroll, to keep up with the increasing size and number of forgings demanded by the increase in size and numbers of locomotives. It is true that steel castings have done away with many forgings, but such large numbers are still demanded that machinery must be made use of in the solution of the problem. Some machine processes which have helped to considerably keep down labor costs at the Chicago shops of the Chicago & North-Western Railway are described herewith.

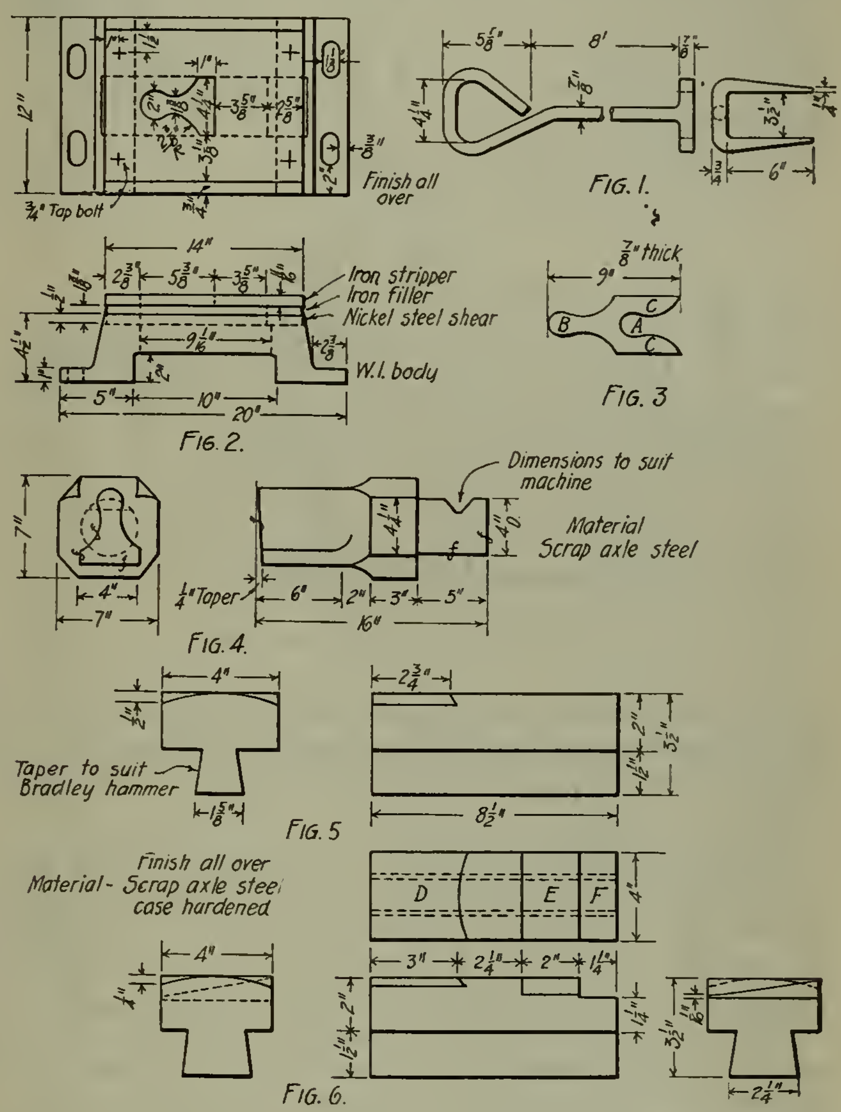
The first example is that of a clinker hook, shown in figure 1. Six distinct operations are required in the manufacture of this piece and the material from which it is made is ⅞x4-inch wrought iron bar stock for the hook and round bar iron for the handle. The piece shown in figure 3 is first punched from the bar by means of the punch and die shown in figures 4 and 2, the space A being first punched off the end of the bar. This is the only waste which occurs in the entire process. The punching is done on a bulldozer.

The second operation consists in heating the punching to a yellow heat and drawing down the shank B to ⅞-inch on a Bradley hammer. It will draw out to about 10 inches in length. At the same heat the drawn-out shank is set in the anvil and the prongs CC are bent out at right angles to the shank. The piece is then reheated and the Bradley hammer again used to draw the prongs down and shape them to their final shape.

The dies used for these operations are shown in figures 5 and 6, figure 5 being the top die and figure 6 the bottom. The space D is used for drawing out, E for smoothing and shaping to proper taper and F for edging.

The next operation is that of bending the prongs of the hooks into their final shape, using a bulldozer. The dies are not shown as the operation is so common. They are simply two cast iron forms bolted in the proper position on the machine. The fifth operation is that of welding the completed hook to the bar, which is done on the Bradley hammer, using ⅞-inch swedge dies.

The sixth and final operation is that of bending the handle loop to the required shape. The bending is done



Dies and Method of Making Clinker Hooks.

Fig. 7. Apparatus for Bending Handle Loop.

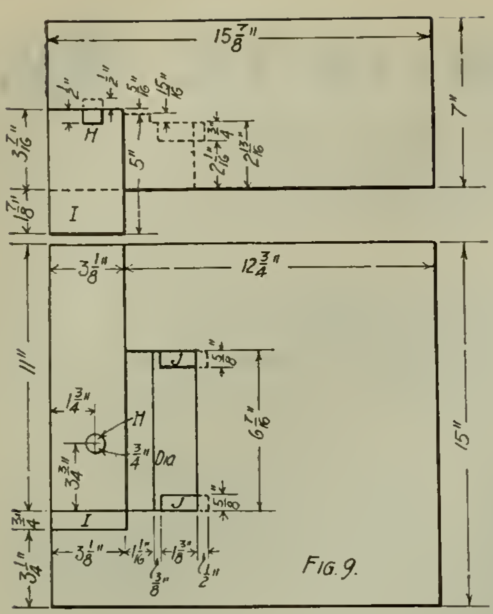


Fig. 9.

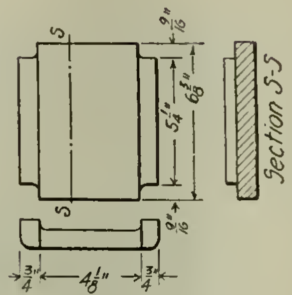


Fig. 8.

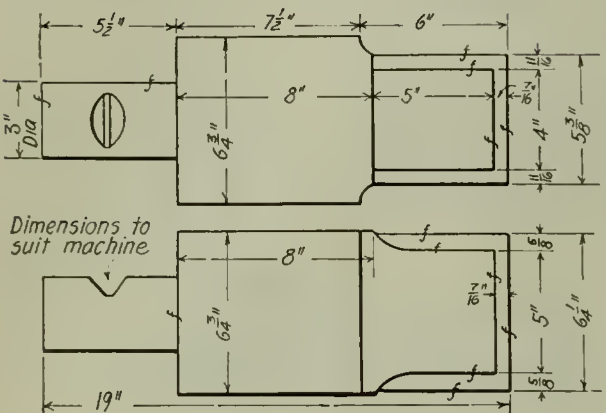


Fig. 10.

Driving Spring Block and Dies.

cold by means of the apparatus shown in figure 7. The former labor cost of manufacturing these hooks has been reduced about 50 per cent by the adoption of the above method.

Another excellent example of the labor saving made possible by the use of machinery is the manufacture of the driving spring block, shown in figure 8. The type of die used in the process is shown in figure 9. Only one-half is shown, as the other die is identical except for the pin H and the plate I and, of course, being opposite handed. A recess is made in the half not shown, to receive the projecting part of the plate I. The plunger used is shown in figure 10.

The material used is 7/8x7-inch wrought bar iron, which is first sheared into pieces 7 inches long. One of these pieces is heated to a yellow heat and placed in the dies, resting on edge on the plate I. The pin H prevents the piece from tipping back. One operation is sufficient to completely form the piece, the shearing, punching and gibbing being done in one blow. This operation is unique in that a shearing operation is done with the dies instead of the plunger, which is usually the case. The hardened tool steel inserts shown at JJ shear off the corners of the piece.

By means of this device, a 75 per cent reduction in labor was accomplished. The size of machine used in this particular case is a 6-inch Ajax, but the operation is possible on a 5-inch machine.

In figure 11 is shown an equalizer hanger, in the manufacture of which considerable saving is possible when machine labor is substituted for fire labor. It is a part, too, which is common on all heavy power of recent construction.

The material required per part consists of one piece of wrought iron 7/8x3x61 inches, one piece 3/8x3x16 inches, and enough scrap iron to form the thick end, which will be about 1 1/8x4x8 inches.

The first operation is to heat the long piece to a yellow heat and, using a bulldozer, bend into a U-shape. At the same heat the U-shape is closed down onto the 3/8x3x18-inch piece, as shown in figure 12. Here again, on account of their simplicity, the dies used to do the bending are not shown.

The second operation is carried out by the use of the steam hammer. The pieces, as received from the bulldozer, are heated to a welding heat and welded together. At the same heat the body is drawn down to 1 3/4x3 inches.

For the third operation, a 6-inch Ajax is used, although the work could be done on a 5-inch machine where a 6-inch is not available. Scrap wrought iron is piled onto the end of the piece to a size of about 1 1/8x4x8 inches. The pile and end is then heated to a welding heat and upset to the final size of the piece. For this operation the bottom recess of the die, shown in figure 15, is used with the plunger shown in figure 13.

The fourth and last operation is done during this same heat. The piece is inserted in the vertical recess of the same dies, and by means of the plunger shown in figure 14 the slot is punched, the recess K, figure 15, taking care of the punching. The corners of the slot are trimmed off

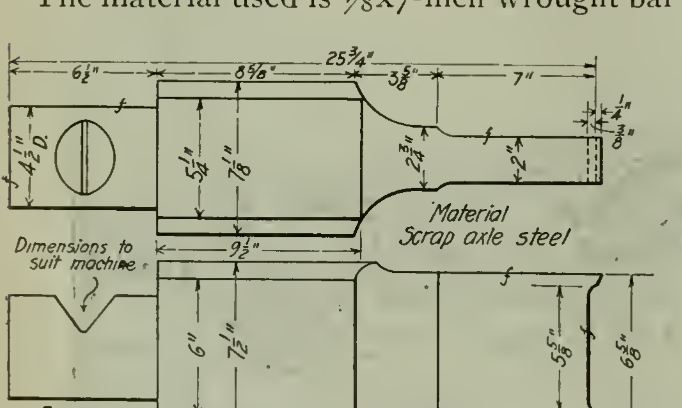


Fig. 13.

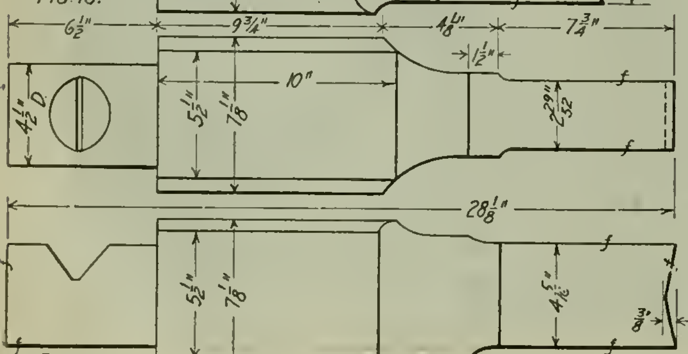


Fig. 14.

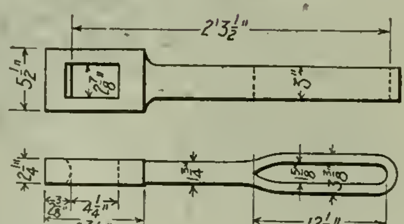


Fig. 11.

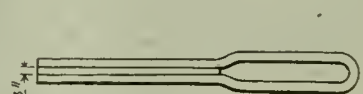


Fig. 12.

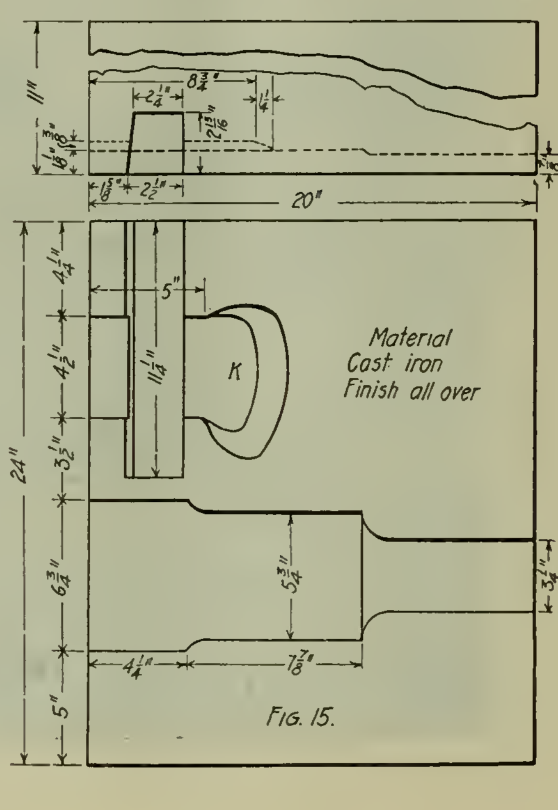
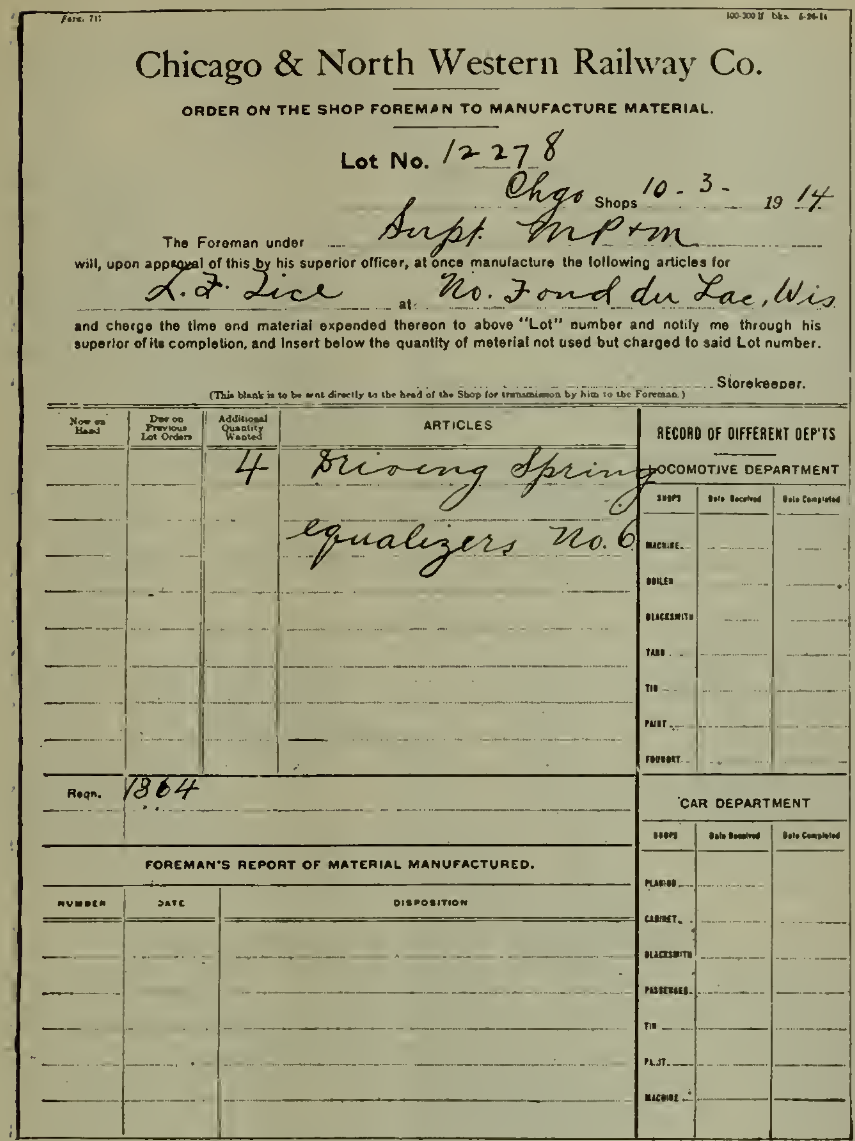


Fig. 15.

Equalizer Hanger and Dies.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Chicago & North Western Railway Co.

ORDER ON THE SHOP FOREMAN TO MANUFACTURE MATERIAL.

Lot No. 12278

Chgo Shops 10-3- 1914

The Foreman under Supt. M P & M will, upon approval of this by his superior officer, at once manufacture the following articles for L. F. Lice at No. Fond du Lac, Wis and charge the time and material expended thereon to above "Lot" number and notify me through his superior of its completion, and insert below the quantity of material not used but charged to said Lot number.

Storekeeper.

(This blank is to be sent directly to the head of the Shop for transmission by him to the Foreman.)

Now on Hand	Due on Previous Lot Orders	Additional Quantity Wanted	ARTICLES
		4	Driving Spring
			Equalizers No. 6

Reqn. 1864

FOREMAN'S REPORT OF MATERIAL MANUFACTURED.

NUMBER	DATE	DISPOSITION

RECORD OF DIFFERENT DEP'TS

LOCOMOTIVE DEPARTMENT

SHOPS	Date Received	Date Completed
MACHINE		
BOILER		
BLACKSMITH		
TANK		
TIN		
PAINT		
FOUNDRY		

CAR DEPARTMENT

SHOPS	Date Received	Date Completed
PLANING		
CABINET		
BLACKSMITH		
PASSENGER		
TIN		
PAINT		
MACHINE		

Order Form, C. & N. W. Ry.

by hand. This method of manufacturing these parts has reduced the cost of labor about 75 per cent.

At first sight, it may appear that there are more operations than necessary on the first and last pieces described, but they are so divided that when the same operation follows itself a sufficient number of times, greater economy is possible than when too much is attempted in the same operation.

Becoming a Leader

We hear a great deal about "faithful service," but it should be borne in mind that "faithful service" alone will not lead to promotion. There are any number of men who are now in the twilight of their days who have been performing "faithful service" for many a long year but who are practically in the same position that they were twenty-five years ago. It is true that they may be getting a larger salary, but the position is the same and they have received increased pay because of long service and not because of a much greater value of their service. When they die their places will be filled by men at one-half the pay and the work will be done just as well and just as faithfully performed. Men are naturally honest and faithful. It is only when some strong temptation comes that they are led astray.

But to become a leader or the head of a department a man must be not only faithful, but forceful and progressive. If he proves his fitness for a higher position he will get it in due time. If not, he will either be dropped or he will keep in the same old groove until death finds him at the same old job or until he is put on the pension list for "faithful service."

Every great railway company or corporation desires to have their men promoted. A man who rises from the ranks and knows the business from the lowest ground up is the most valuable man.

Before a man can become a leader or the head of a department, he must acquire the one habit that is characteristic of all leaders—the habit of making good. Making good does not mean doing your work so that it will be approved. The work must be done so that it will not only be done well, but nothing from it will "come back" for criticism.

A man should strive to improve the methods by which his work is done. A man should study the methods of men above him who have won their positions by ability. A man must work, he must develop his mind, he must study all things that will make him more valuable to his company, he must take care of his health, he must be honest with all men and particularly with himself, he must know his own business and he should keep himself posted on all competing lines of business.—*Graphite.*

The Nerves of the Engineer

One of the questions being seriously considered in the arbitration of the differences of the locomotive engineers and employing railway companies is whether the engineers shall hereafter be subjected to "surprise tests." The railway companies contend that many accidents, according to reports of the Interstate Commerce Commission, are due to engineers failing to heed block signals. They argue that it is necessary to use unexpected signals at times to test the vigilance and the reliability of the engineers. On the other hand, the engineers complain of the practice as needless torture. One witness stated that twice he had undergone the experiment of test signals. When it was suggested that two such experiences in several years surely caused no great hardship, he responded that two such trials were enough for one lifetime. Other witnesses bore him out and gave specific instances of where men subjected to surprise tests had jumped from their engines in terror, receiving serious injuries.

While the general public is not qualified to decide the controversy, the discussion reveals a feature of railway life to which few have given any heed. The life of a locomotive engineer appeals to the imagination. With his hand on the throttle which controls the movements of the steam monster, he seems a monarch, the very embodiment of man's mastery of nature.

The man who walks carelessly across a railway track in front of an onrushing train forgets it. The man who runs across, as if in the greatest hurry of his life, although he usually turns around and watches the train go by, also forgets it. He feels that he is safe. But the engineer is alarmed. He does not know but that the man is deaf. The train has such a momentum that it could not be stopped. Old engineers say that they have had their nerves shattered by such incidents. One who admitted that his gray hairs did not come from age thus described it: "If you were swinging an ax and a child should quickly place its finger between the ax and the log, how would you feel? This is the kind of experience that every locomotive engineer must suffer, sometimes many times a day. The fatalities are infrequent, but no mathematical computation of probalibities can remove the anxiety of the helpless engineer. He dreads what may easily happen." If the public could but realize the position of the man in the cab he would be spared many nerve-racking experiences. Furthermore, many needless accidents would be avoided. One of the slogans of the Safety First movement should be: "Put yourself in the engineer's place."—*St. Louis Globe-Democrat.*

Suburban Type Locomotives for the Grand Trunk Railway

Due to the Necessity of Hauling More and Heavier Cars, Six Powerful Units Have Been Placed in Service at Montreal

Six suburban type locomotives have recently been delivered to the Grank Trunk Railway by the Montreal Locomotive Works, Ltd. These locomotives have been put in service between Montreal and Vaudrieul, a distance of 24 miles, and between Montreal and St. Hyacinthe, a distance of 37 miles. Where this kind of traffic is frequent, the suburban type engine can be used to good advantage. Delays caused by turning the locomotive are eliminated, as the suburban type can run in either direction with equal advantage.

This traffic on the Grand Trunk was formerly handled by 4-4-2 suburban type locomotives having 17"x22" cylinders and a total weight of 128,600 pounds. As this traffic increased 20"x26" moguls and ten-wheelers were also used. New suburban cars have recently been placed in service which weigh 138,000 pounds as compared with 75,000 pounds weight for the older class of car. As it was also desired to increase the number of cars in a train, it became necessary to design a more powerful engine. Former experience with the traffic and the different types of engines used influenced the railway officials in deciding on the suburban type for the new power. These new engines are handling an average train of seven cars. Trains of five cars were the average with former power.

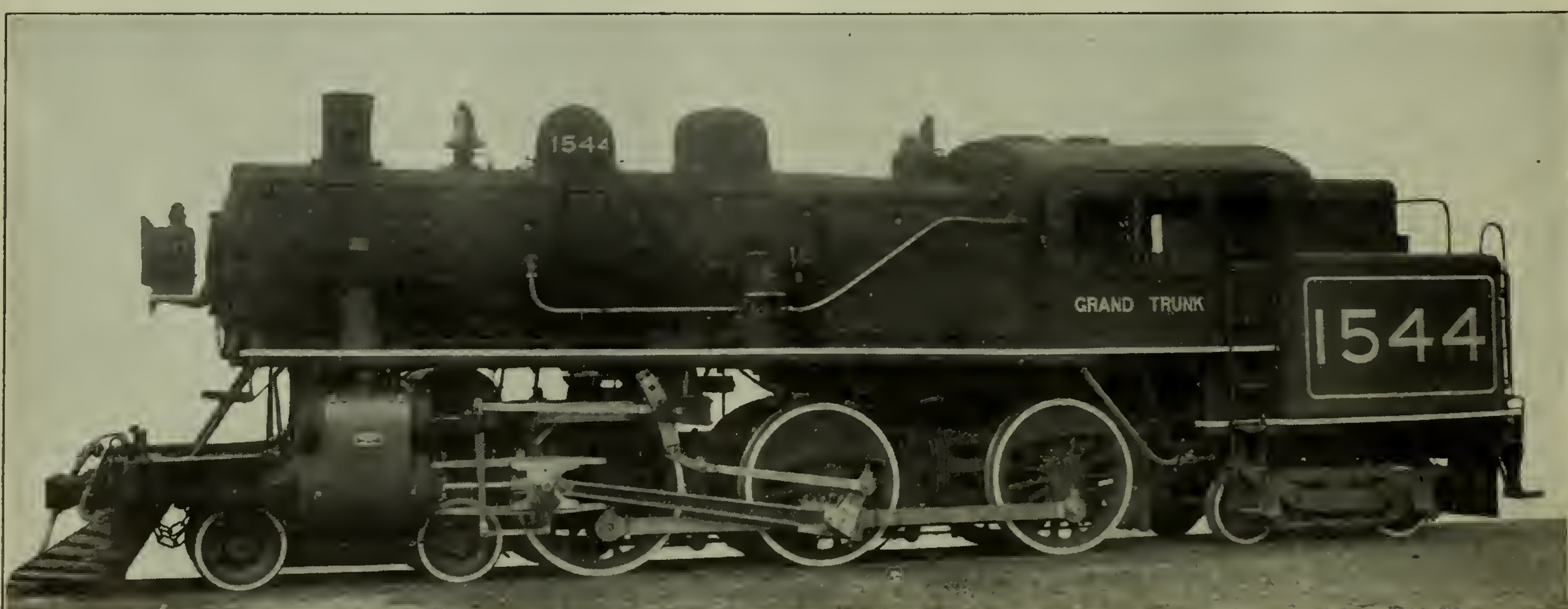
The design in general follows the standards of the builder. An interesting feature is the combination of the Gaines combustion chamber and a Security brick arch. This combination secures a very complete deflection of the gases whereby better combustion is obtained; the back end of the firebox is more fully utilized, with a resulting increase in the generation of steam; and the amount of smoke is reduced to a minimum, which is so important in this kind of service. The front truck is equalized with the drivers, as it was not desired to have more than two systems of equalization. Other features are: a Schmidt superheater, outside steam pipes, self-centering valve stem guide, extended piston rod, the improved throttle lever bracket which has also been applied on the Mikados for this road, long main driving box, and vanadium main fumes.

Other data with regard to these locomotives follows:

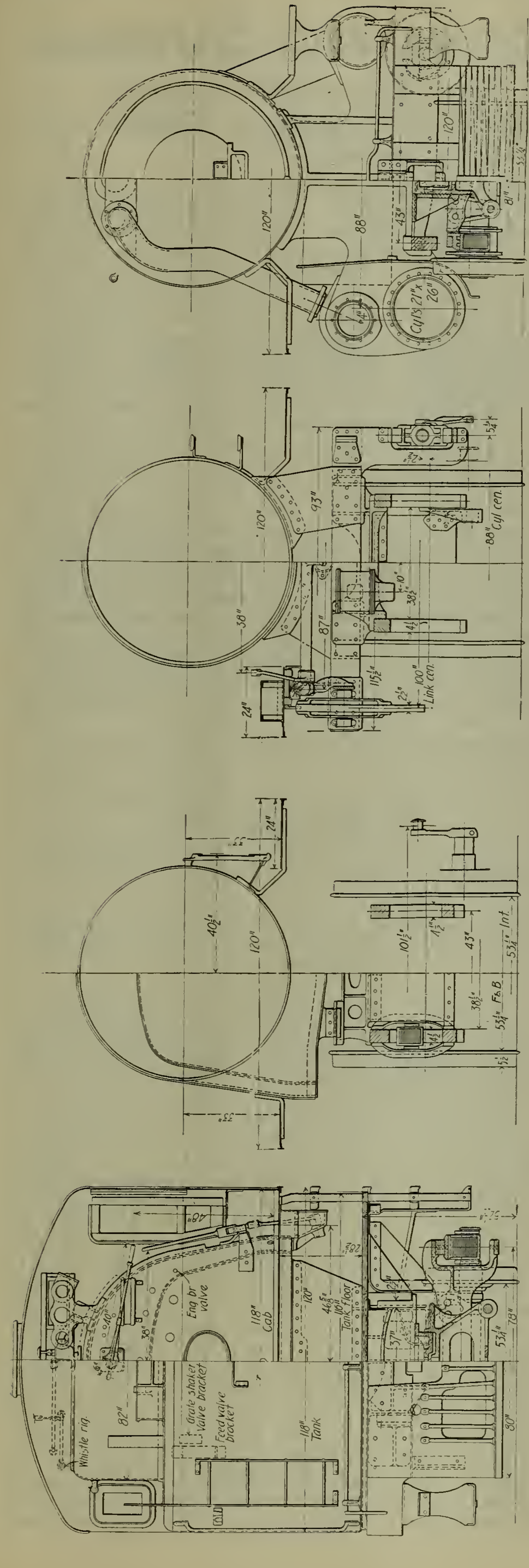
Cylinder, type	Piston, 21"x26"
Tractive power	30,940 lbs.
Factor of adhesion	4.7
Wheel base, driving	15'-11"
Wheel base, total	38'-11"
Weight in working order	262,000 lbs.
Weight on drivers	146,000 lbs.
Weight on trailers	67,000 lbs.
Weight on engine truck	49,000 lbs.
Boiler, type	Straight top, radial stay
Boiler, O. D. first ring	71 9-16 in.
Boiler, working pressure	200 lbs.
Firebox	Wide, 129 in. x 75¼ in.
Firebox, thickness of crown, ⅜"; tube, ½"; sides, ⅜"; back, ⅜".	
Firebox, water space front	5"; sides 4½"; back, 4½"
Heating surface, tubes and flues	1,604 sq. ft.
Heating surface, firebox	173 sq. ft.
Heating surface, arch tubes	31 sq. ft.
Heating surface, total	1,808 sq. ft.
Superheater surface	347 sq. ft.
Crate area	47 sq. ft.
Wheels, driving dia. outside tire	63 in.
Engine truck	4 wheel center bearing
Trailing truck	4 wheel center bearing
Grate, style	Rocking bars, G. T. std.
Piston rod, dia	3¾"
Tank, style	Waterbottom
Tank, capacity	3,500 U. S. gal.
Tank, capacity fuel	5 tons

Engineering of the Panama Canal

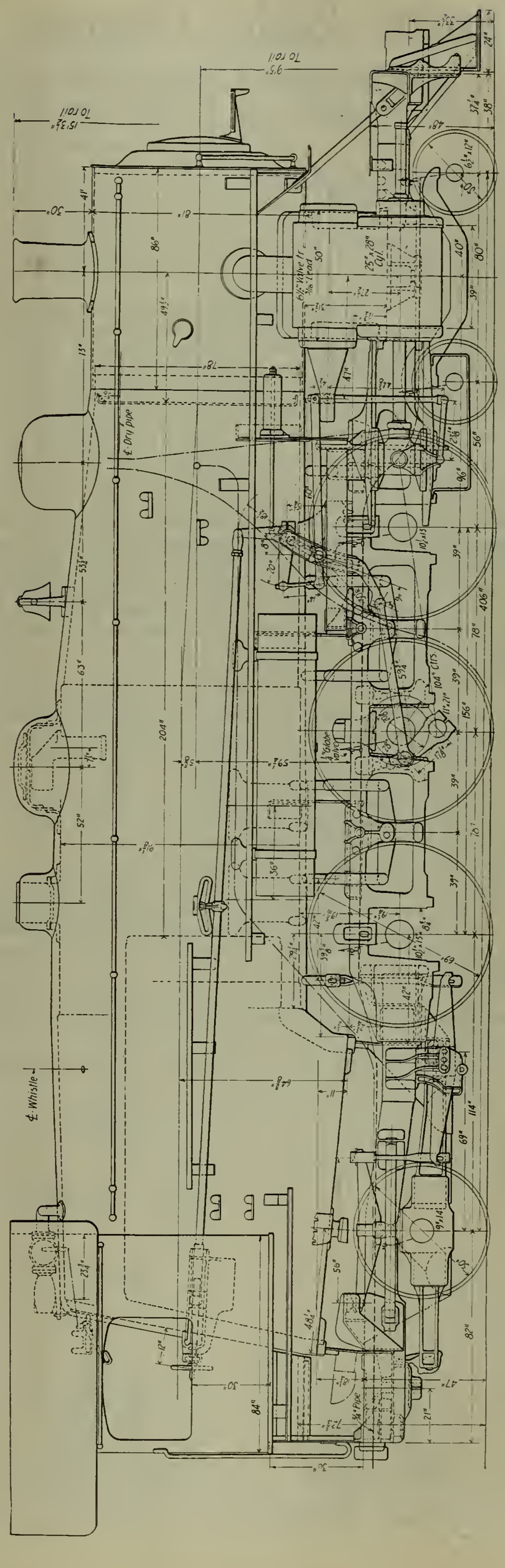
Volume I of the Transactions of the International Engineering Congress will comprise a unique series of papers on the engineering of the Panama Canal. The various topics and subdivisions of the work have been arranged by Colonel G. W. Goethals, Chief Engineer of the Canal, and now Governor of the Canal Zone. Colonel Goethals has also selected the author for the treatment of each paper, and he will himself contribute the introductory chapter. The various authors are in general the officers who were in direct charge of the actual work of construction, and the collection of papers thus becomes a first-hand account of the engineering of the Panama Canal, written by the men who were in immediate and responsible charge of the undertaking. There will be twenty-four papers in all, profusely illustrated, twenty-two of which deal with actual constructive and engineering problems connected with the work, one with the preliminary work in municipal engineering in the Canal Zone, and one with the commercial and trade aspects of the Canal.



Suburban Type Locomotive, Grand Trunk Ry.



Sections of Grand Trunk Suburban Type Locomotive.



Elevation of Grand Trunk Suburban Type Locomotive.

Truck Side Frame Forces and Stresses*

Comprehensive Tests Recently Made Have Contributed Valuable Information as to the Proper Distribution of Metal in Frames

By L. E. Endsley, Prof. Ry. Mech. Engr., Univ. of Pittsburgh

The design of the different members of a freight car truck for a good many years has received careful attention, but so far as the writer knows, no definite information has ever been obtained with regard to the actual force coming on the side frame, until the work herein described was undertaken.

The object of these experiments was to obtain the actual force coming on the truck side frame and from the force thus obtained, to check some test on a truck side frame in which the writer has assumed certain forces.

The three main forces to which the side frame is subject are, the downward spring pressure, the end thrust of the bolster, and the twisting of the side frame which the spring plank gives it when the car is on a curve and the inside pair of wheels is attempting to get ahead of the outside pair of wheels. Of the three forces just mentioned, the maximum direct vertical force had often been estimated and was generally considered to be not over twice the normal load on the frame when the car was standing still. That is, the vibration of the car up and down on its spring might carry the pressure underneath the spring from almost nothing to double the normal load.

Some years ago, experiments were conducted by placing in the center of the spring a short block of wood in which a nail was driven, and as the car body moved up and down, the upper spring cap would drive the nail deeper and deeper into the wood, and from this the total compression of the springs was obtained. But so far as the bolster pressure against the side of the frame and the twist of the spring planks, nothing in the writer's knowledge had ever been attempted.

APPARATUS USED TO DETERMINE FORCE ON SIDE FRAME.

The car used in the test was a Pennsylvania standard H 21 hopper, which had special cast steel trucks under it. One truck was designed to obtain the direct vertical load, and the other to obtain the bolster thrust and the twist of the spring plank.

The apparatus used to determine the maximum direct vertical load, one end of which is shown in Fig. 1, consisted of two new sets of standard M. C. B. coil springs, which were calibrated. Two special spring caps were used. An arm extended inward from each spring cap carrying a ratchet which revolved a shaft that extended across the truck. These ratchets were so designed that as the spring cap moved up and down, the shaft would revolve in one direction. An arm, also extending outward, carrying a vertical link which was connected to a slide in which a horizontal pencil was held. The slide moved up and down in a small box that contained three vertical cylinders, which carried a scroll of paper. These three cylinders were so geared to the shaft running across the truck that the paper was unwound from No. 1 cylinder, wound up on No. 3 cylinder, and passed almost one-fourth the way around No. 2 cylinder. As the axis of the cylinders were all vertical, and the paper moved around the cylinder, the pencil would make a saw-tooth mark on the paper. In this way the exact movement of the spring cap up and down was obtained. Fig. 2 shows a typical record. It will be seen that the distance between any two saw-tooth was equal to about one-fourth the total movement up and down. In order that the record on the two sides of the truck could be connected, the No. 2 cylinder on each side had a small point sticking up that pricked a hole in the paper every time the cylinders made one revolution. As the gearing was so constructed that the No. 2 cylinder on each side made the same number of revolutions, it only remained to make a reference mark at the beginning of each scroll of paper to connect the record on each side.

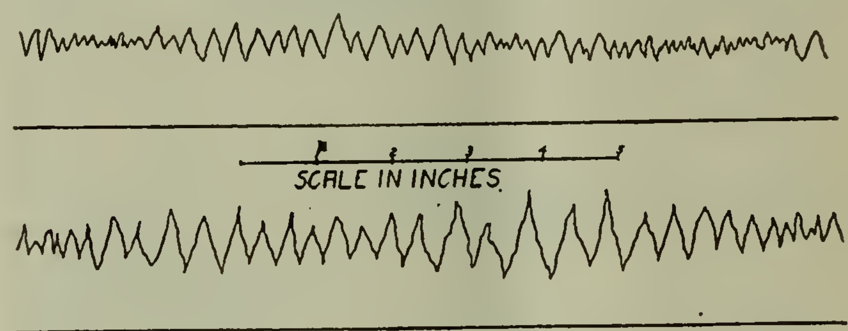


Fig. 2. Vertical Record for Determining Direct Vertical Load on Side Frame.

The apparatus used in getting the thrust of the bolster consisted of a specially constructed bolster, shown in Fig. 3, which had a solid web cast across it at A, on each side of which was a calibrated spring which was placed under an initial compression of about one-half its capacity by tightening the bolt running through what might be called the spring heads C and G. Connected firmly to the spring head were two rods, shown in Fig. 3, at D and D, and extending to each end of the bolster.. These rods, D and D, were threaded and passed through two striking blocks, E and E. The striking blocks served as the lugs on the ordinary bolster, but in this case they were only on the inside of the frame. These striking blocks were held from moving across the bolster by the end of rods D and D passing through a bushing in the end of the bolster, and any movement of these blocks endwise of the bolster would be resisted by the springs. That is, any movement of the right hand block inward would compress the right hand spring and release the left hand spring, and any movement of the left hand block

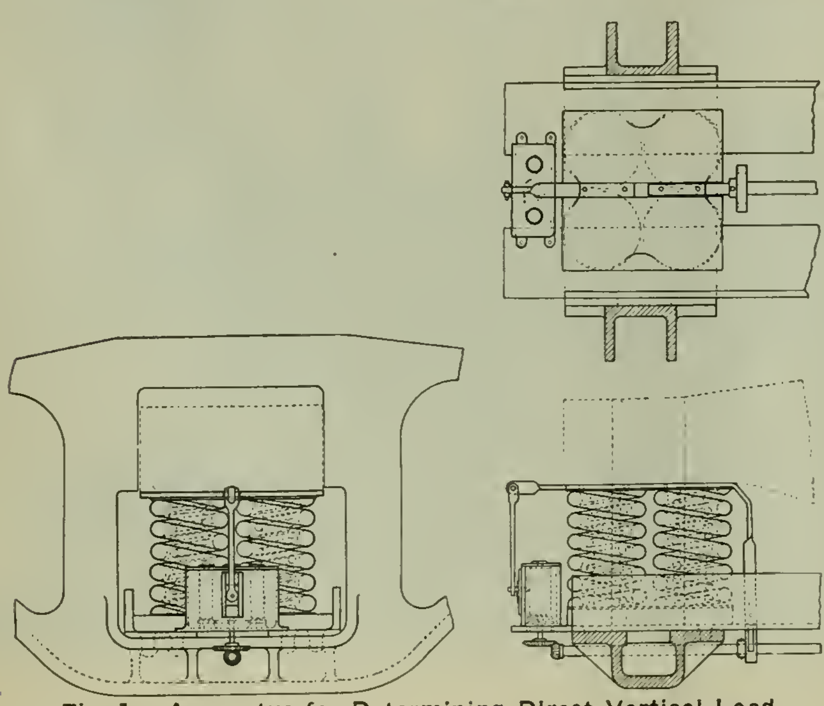


Fig. 1. Apparatus for Determining Direct Vertical Load.

* A paper presented before the Railway Club of Pittsburgh.

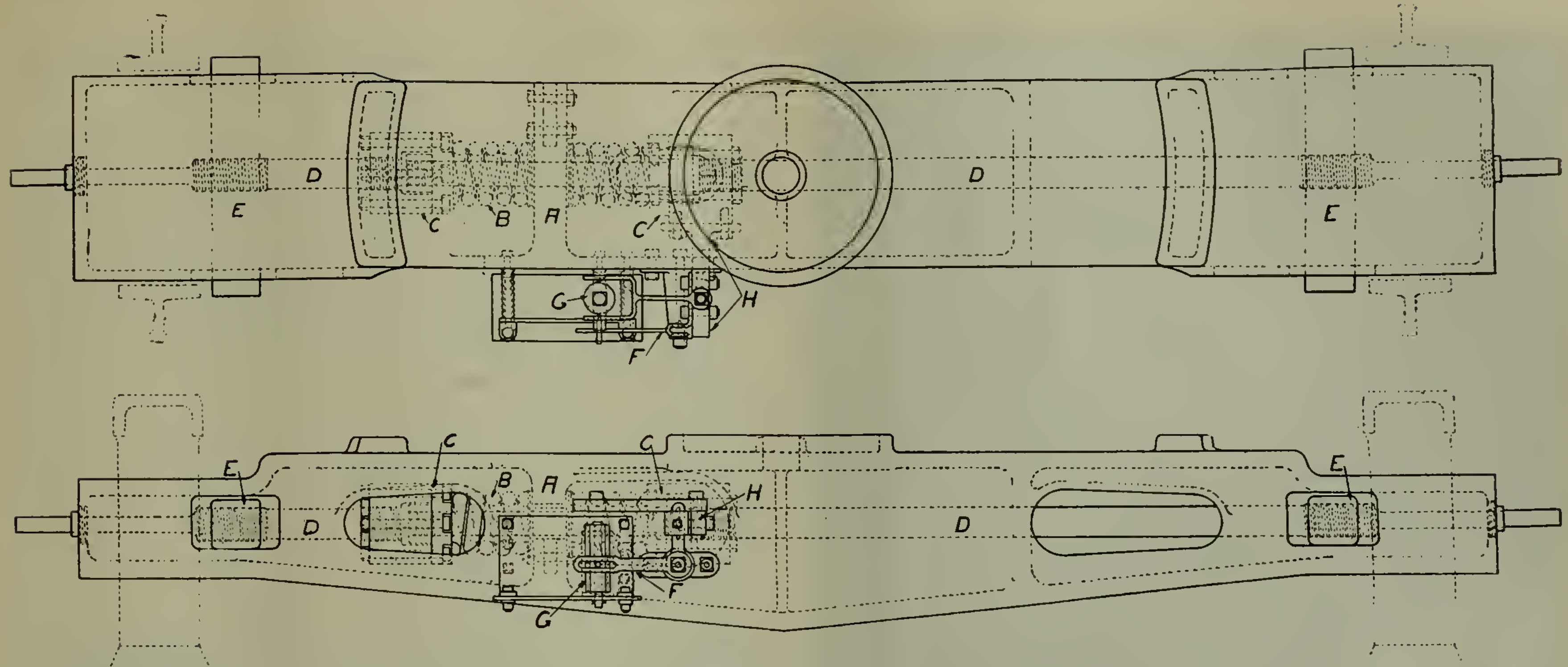


Fig. 3. Special Bolster and Recording Mechanism.

inward would have the opposite effect on the spring. In this way the force exerted on either block for any given movement would be equal to twice the calibration of one spring for this movement. So by knowing the initial pressure on each spring (which must be equal with no force on either block) and the calibration of each spring and the movement due to any force on the block, the exact force was obtained from the calibration curves of the springs. It so happened that the two springs were identical. The movement of the spring head with regard to the bolster was obtained by recording the movement of the arm H, which was fastened to one spring head and extended out through a slot in the side of the bolster. This movement was recorded on the copper drum G, by means of a bell-crank F, which moved a steel point up and down the drum. The drum was caused to revolve by means of a ratchet connected to the base of the drum and the arm H. In this way any force on the blocks would cause arm H to move with respect to the bolster, and as the drum G was mounted on the bolster, the steel point would move up and down, and the ratchet would revolve the drum, thus making a saw-tooth record on the drum, and from this record the maximum force was obtained.

The apparatus shown in Fig. 4 was used to obtain the force on the side frame due to the twist of the spring plank. It consisted of a spring plank made up of two similar shaped castings, A and B, which were fastened to the side frames by eight (8) machine taper bolts. These two castings were held together by a bolt C, that extended through holes in the casting and held two springs, one between the two parts, A and B, and one on the outside of B. This bolt had an initial tension of approximately one-half the capacity of the springs. In order to space the two side frames the correct distance apart so that the bolt in the center would not bind, the angle F was bolted to the two pieces.

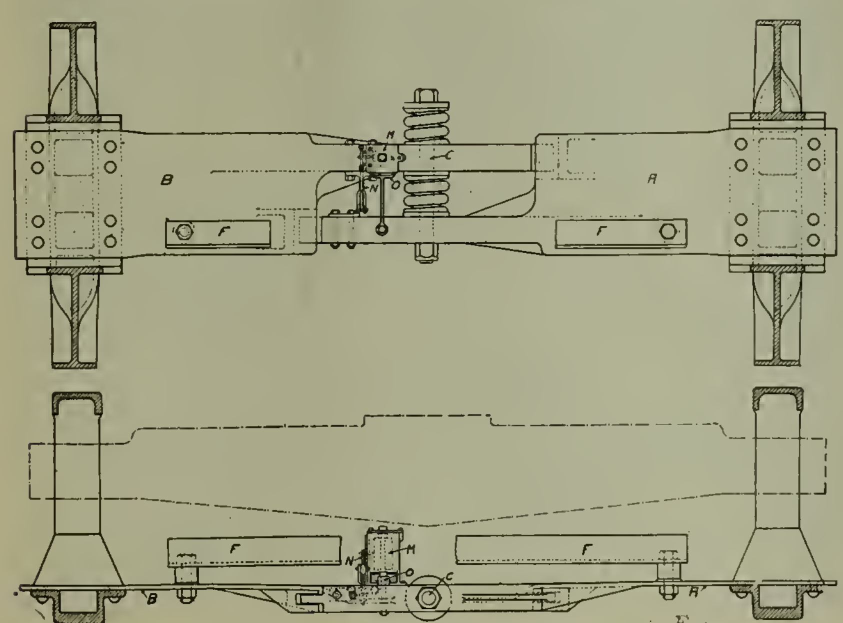


Fig. 4. Apparatus for Determining Twisting Force of Spring Plank.

The recording arrangement was very similar to that just described for the bolster. It consists of the drum M, the bell-crank N, and the ratchet O.

METHODS OF TESTING TO OBTAIN FORCES.

After the car was equipped, as already described, it was first tested light, by putting it next to a switch engine in the Allegheny yards of the Pennsylvania Railroad. This was done in order that minor adjustment of the apparatus might be made and the whole thing tried out, after which the car was put in a local freight train and repeated round trips from Pittsburgh to Alliance were made. The test with the car in the local freight train was conducted with the car running light (48,700 pounds) and with a 66,000-pound load, 91,000-pound load and 119,150-pound load, making the total loads as tested 48,700, 114,700, 139,700 and 167,850 pounds. After this the car was put in fast freight service between Pittsburgh and Alliance with a load of 91,000 pounds in the car, a total of 139,700 pounds. All of the tests were conducted between the Allegheny shops and Alliance, except the one round trip which was made with 91,000 pounds in the car between Pittsburgh and Altoona in fast freight service to obtain the force due the twisting action of the spring plank.

RESULTS OBTAINED.

Table No. 1 gives the results obtained with regard to the maximum direct vertical force on the side frame.

The first three columns are self-explanatory. Column No. IV gives load in pounds on the side frame with the car standing still. These values were obtained by subtracting the weight of the wheels, axles, side frames and journal boxes from the total weight of the car, and dividing the remainder by four. Column No. V gives the maximum pressure obtained on the direct vertical load. This was obtained from the record made of the maximum compressing of the springs as recorded on the paper in the boxes at each end of the spring plank.

The first four values in this column were obtained while

Test	Kind of Service	Load on Car	Load on Truck Side Frame Normal	Maximum Pressure on Side-Frame Lbs.	Maximum Load in Per Cent. Normal
I	II	III	IV	V	VI
1	Local	None	8175	16400	200
2	"	None	8175	15800	193
3	"	66000	24675	52800	214
4	"	66000	24675	45000	182
5	Through Freight	91000	30925	66600	216
6	"	91000	30925	76000	246
7	"	91000	30925	60000	194

Table I. Results of Tests to Determine Maximum Vertical Pressure.

the car was equipped with M. C. B. standard 100,000 pounds capacity springs, each of which has a capacity of 64,000 pounds before going solid, while the last three values were obtained with special springs, each having a capacity of 104,000 pounds before going solid.

Column No. VI gives the total load in percent of the normal, and was obtained by dividing the values in column No. V by those in column No. IV.

Test	Kind of Service	Load on Car	Load on Truck Side Frame Normal	Bolster Thrust in Lbs. on Side Frame Maximum Right	Left	Bolster Thrust in Per Cent. of Normal Load on Side Frame Right	Left
I	II	III	IV	V	VI	VII	VIII
1	Local	None	8175	4300	4600	52.6	56.2
2	"	66000	24675	5900	9200	24.0	37.4
3	"	119150	38463	5900	9500	15.4	25.4
4	"	91000	30925	8500	7500	27.4	24.2
5	"	91000	30925	5400	5300	17.4	17.2
6	"	91000	30925	4000	5100	13.0	16.5
7	Through Fast Freight	91000	30925	4900	7500	15.8	24.2
8	"	91000	30925	7300	7300	23.6	23.6

Each Test Represents a Round Trip, Pittsburgh to Alliance.

Table II. Results of Tests to Determine Maximum Bolster Thrust.

Table No. II gives the results obtained with regard to the maximum pressure set up between the bolster and side frame, due to the end thrust of the bolster against the columns of the frame. The first four columns of the table are the same as those of table No. I. Column No. V gives the maximum pressure between the right side frame and the right striking block; column No. VI gives the maximum pressure between the left side frame and the left striking block; column VII and VIII gives the maximum pressure in percent of the normal load obtained by dividing columns V and VI (respectively) by column No. IV.

Test	Kind of Service	Load in Car	Load on Truck Side Frame Normal	Twisting of Spring Plank in Lbs. at Center of Truck Maximum	Twisting Load in Per Cent of Normal Load on Side Frame
1	11	111	IV	V	V1
1	Local	None	8175	3000	36.7
2	"	66000	24675	3975	16.1
3	"	119150	38463	4975	12.8
4	"	91000	30925	5050	16.3
5	"	91000	30925	5050	16.3
6	Through Fast Freight	91000	30925	5550	18.0
7	"	91000	30925	6100	19.6

First six tests represent trips from Pittsburgh to Alliance and return. No. 7 test represents trip from Pittsburgh to Altoona and return.

Table III. Results of Tests to Determine Maximum Twisting Force.

Table III gives the results obtained with regard to the maximum force due to the twisting action of the spring plank on the frame. The first four columns are the same as those in the two former tables; column V shows the maximum force due to the twisting action of the spring plank on the frame obtained at a leverage of half the width of the truck; column VI gives the twisting load in percent of the normal load on the frame as obtained by dividing column V by column IV.

MAXIMUM FORCES COMING ON TRUCK.

From a survey of the results obtained in Table No. 1, it will be seen that the maximum direct vertical pressure will vary from 182 per cent to 246 per cent of the normal load on the frame. The results, however, show that only in one case does the maximum load exceed 216 per cent of the normal load, so that for the design of a freight car truck probably a conservative figure would be 220 per cent of the normal load on the frame.

We found, however, during three round trip tests between Pittsburgh and Alliance, in which the standard M. C. B. springs were under the car and the total weight of the car was 139,700 pounds, that the springs went solid several times during each trip of eighty miles. This would indicate that a force of over 64,000 pounds, which was the capacity of the springs, came upon the springs.

After it became evident that these springs were going solid, the car was equipped with four new sets of springs, each having a capacity of 104,000 pounds, and three round trips were made, the results of which are given as the last three lines in column V of Table No. 1. These results would indicate very clearly that the standard M. C. B. springs do not have high enough capacity, that forces of over 70,000 pounds were not unusual with a normal load of 30,925 pounds on the frame. Now, if we consider for the average 100,000 pound car, weighing 40,000 pounds and loaded to 110,000 pound capacity, making a total weight of 150,000 pounds, that the wheels, axles, side frames and journal boxes are not carried by the springs, the normal load carried by each spring would approximate 33,000 pounds. If we consider that 220 per cent of this load—the maximum force for design would be 72,600 pounds for each frame. This is somewhat higher than most companies have used in their design—68,500 pounds being a common figure. Then in view of the fact that the springs are going solid, it is almost impossible to predict what maximum force might be obtained due to the impact after the springs go solid. This fact may account for a great many of our failures in arch bar and cast steel side frames.

From a study of Table No. II, it will be seen that the force obtained due to the end thrust of the bolster against the columns of the frame, referred to hereafter as the transverse load on the frame, varied considerably—but the maximum with the total weight of the car—167,850 pounds—was 9,500 pounds, or 25.4 per cent of the normal load on the side frame. This 25.4 per cent of the average load on a side frame on a hundred thousand pound capacity car would be about 8,500 pounds, and probably for safe figuring, 9,000 pounds would be the maximum force for test purposes.

From Table No. III it will be seen that the twisting force reached a maximum in the trip from Pittsburgh to Altoona, and as this force is dependent upon the degrees of curvature, this is readily explained, as this track has one or two curves of eight degrees curvature, and the track between Pittsburgh and Alliance has no curve of over five degrees. The maximum force obtained was 6,100 pounds, from which we may assume that 6,000 pounds would probably be a safe figure for test.

FORCE USED IN TEST OF SIDE FRAME.

The last part of this paper, which deals with the actual stress in the side frame, is taken from the results obtained from the tests of some forty different designs of side frames, using three forces acting on frame as described above. The exact amounts of the three forces were not the same as those found in actual service, due to the fact that the tests conducted to determine the stress set up in the side frame were made before the tests to determine the actual maximum force were carried out. And for the purpose of this paper only the complete results from two different designs of frame will be included.

As has been previously given in the report the three forces, namely, direct vertical, transverse and twisting, were found to have maximum values for a hundred thousand pound car of 72,000 pounds, 9,000 pounds and

6,000 pounds, respectively. The actual forces used in the testing hereafter described were 68,500 pounds direct vertical—6,000 pounds transverse and 5,000 pounds twisting. However, in the tables hereafter described, the results due to the transverse load have been increased 50 per cent and represent the stress due to a transverse load of 9,000 pounds. There might be some question in this procedure, if it had not already been found in actual test that for all practical purposes the stress at any point in the frame was directly proportioned to the loads as long as the elastic limit of the metal was not reached.

METHOD OF TESTING TO DETERMINE STRESSES.

For the purpose of determining the stress throughout the frame under the three different loads, namely, direct vertical, transverse and twisting, the Berry strain gauge was used. These gauges are so constructed that the elongation in two-inch gauge length can be determined to .0002 of an inch. This gauge is shown in Fig. 5.

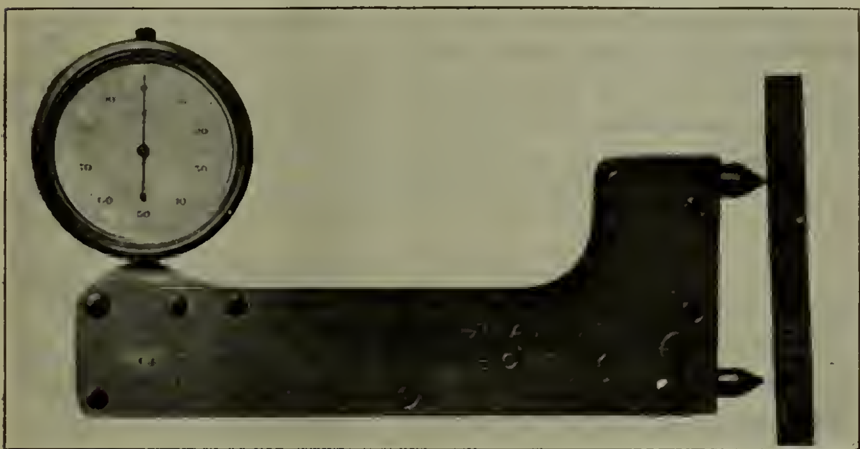


Fig. 5. Berry Strain Gauge.

It will be seen that the dial of the instrument is divided into 100 parts. The movement of the hand over each of these divisions, which is approximately one-sixteenth of an inch, is equivalent for the cast steel used in these tests to 2,700 pounds per square inch stress. This 2,700 value was arrived at by determining the modulus of elasticity of the steel which from several tests was found to be approximately 27,000,000.

I will say that this instrument is a delicate machine and it requires some patience and skill to operate. A common day laborer could not obtain accurate results.

In preparation for a test the frame was mounted as shown in Figs. VI and VII, on two heavy supporting castings on the bed plate of the testing machine. The machine used was a 300,000 pound Richle testing machine, located at the Granite City plant of the American Steel Foundries. The distance between the support was equal to the wheel base of the truck. Double knife edge bearings over the supports were used. Cap castings over the support and filler blocks were also used to obtain the correct height for the spring seat and to support the knife edges. Any irregularities on the bearing surfaces of the frames were taken up by the use of half-inch soft wooden blocks between the top filler blocks and the frames. The direct vertical load was applied through the casting A (which was bolted to the head of the testing machine as shown in the figures) to a 1-inch by ⅜-inch by 10-inch strip lying over the center line of the spring seat. It was then transmitted through a 1-inch by 3-inch by 8-inch filler block to the circular ball bearing B, which rested on the steel casting C, used to take the place of the spring plank in the tests. Wooden blocks were used above and below the ball bearings to take up any irregularities on the surface of the casting or in loading. A special spring plank casting was placed on the spring seat and a load was transmitted through it to the spring test. The thickness of this special spring plank underneath the ball bearing was one-half inch. The twisting load was applied through this special designed spring plank casting C, which was bolted to the side frame by eight ¾-inch bolts. The load was applied to the calibrated spring D, and was transmitted through the lever casting E to the spring plank casting. After the vertical load was applied, any desired twisting load could be applied without danger of moving the side frame upon its support. The transverse load was obtained by applying a load to the calibrated springs F, which were anchored to the frame by means of bolts G, castings H, which hooked under the edge of the journal box seat, through the casting I, and column casting J, to the columns. After the frame had been selected for the test, the points of reading were located, and small holes were drilled with a No. 56 drill into the casting about one-eighth inch deep, exactly two

Fig. 6. Method of Mounting Frame.

Fig. 7. Method of Mounting Frame.

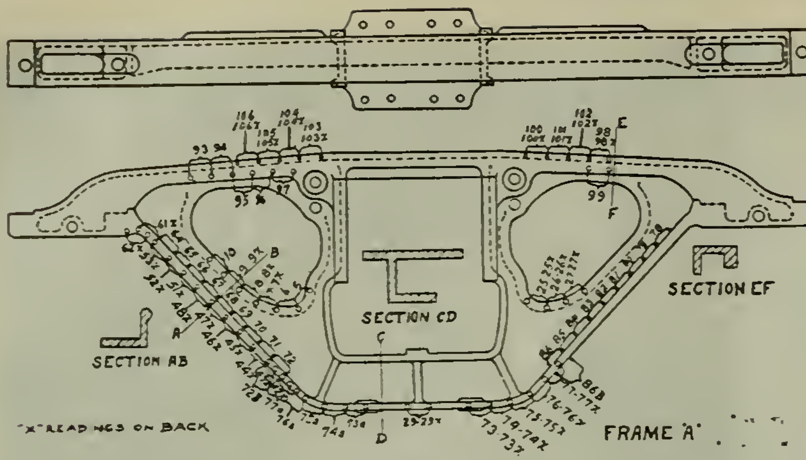


Fig. 8.

inches apart, and these holes were then reamed to get a good firm surface for the points of the instruments to rest in. The frame was then mounted in the testing machine, as already described. As we had several instruments they were clamped at different positions around the frame where the readings were desired, and 5,000 pounds vertical load was applied to the frame. A zero reading of all instruments was then taken, after which the direct vertical load was increased to 73,500 pounds and the instruments were all read again. A twisting load equivalent to 5,000 pounds was applied to the center of the spring plank and another reading of each instrument was taken, after which a 6,000-pound transverse load was applied to the calibrated spring F, and a fourth reading of the instruments was taken. From these four readings taken, the stresses equivalent to each of the loads at any point was determined by repeating the above tests until all points where readings were desired had been covered.

DESCRIPTION OF FRAME USED.

The two frames which will be discussed in this paper were from two general types of design, designated according to the cross section of the different members in the frames, namely, the "L" section and the "I" section. The "L" section type is as shown in Fig. 8 and will for

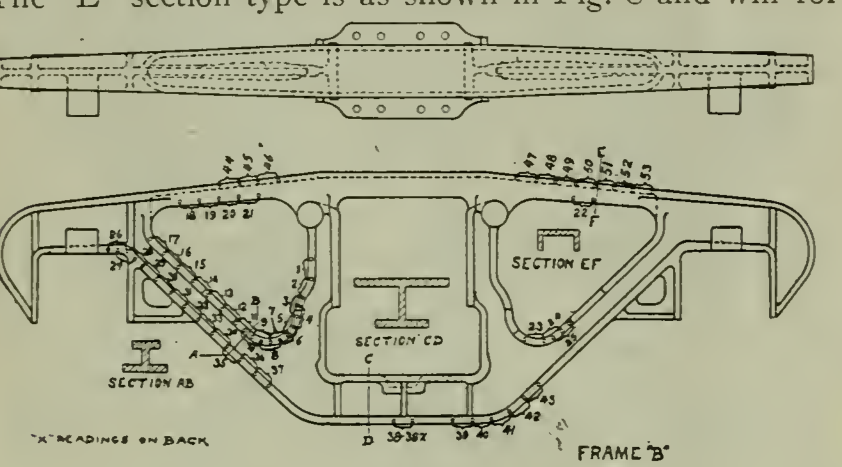


Fig. 9.

this paper be referred to hereafter as frame A. This design of frame has been discarded by the manufacturers.

The "I" section type, as shown in Fig. 9, is a later type of design and will hereafter be referred to as frame B.

Several changes in the B type of frame were made as the tests progressed. For instance it was soon found that a B type of frame with the ordinary bead around the inside of the triangular opening was apparently weak at points 11 and 25, so that frames of this type having different width beads from points 4 around to 15 were made. Also it was found that the width of the bottom flange had a considerable effect upon the stress derived, due to the twisting force of the spring plank, so that frames having different widths of bottom members were tested.

RESULTS OBTAINED.

Table IV gives the results obtained from the tests made on the A frames under the three loads as described above. The weight of the frame as tested was 402 pounds. Column No. 1 gives the position of reading on the frame and the numbers in the table correspond to the number in Fig. 8. It will be seen that some numbers are omitted, which is due to the fact that only points of maximum stress or especial significance are considered in this paper.

Column II gives the stress under vertical load of 68,500 pounds. The negative signs in the table represent compression.

Column III gives the stress for a 5,000-pound twisting force applied from the side frame at a distance equal to half the width of the truck.

Column IV gives the stress corresponding to a transverse load of 9,000 pounds.

Column V gives the maximum calculated stress at the different positions on the frame under the direct vertical, twisting, and transverse loads.

In determining this column of maximum stress due to the direct vertical, twisting and transverse loads the following assumptions were made:

(1) That a full direct vertical load as used was always acting.

(2) That the stresses due to twisting and transverse loads would add to or subtract from the stresses due to the vertical.

(3) That either one, or both, the transverse or twisting loads might be acting or dormant.

Table V gives the results obtained from the tests on frame B. This frame weighed 435 pounds. It will be seen that this frame weighed 33 pounds more than frame A. This, however, would not be true if the frames had similar design of ends, as they would weigh within 1 per cent of each other if they had the same ends.

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
5	−5400	None	None	−5400
6	9700	1100	None	10800
7	20200	−1400	800	21000
7x	6500	−3000	1600	8100
8	16500	−2300	1600	18100
8x	5400	−2700	None	5400
9	10000	−2200	2400	12400
9x	4600	−1900	None	4600
10	6200	−800	None	6200
25	8100	−1600	−500	8100
25x	−2200	−3800	None	−6000
26	21200	1900	1100	24200
26x	5700	4000	2200	11900
27	24500	3500	800	28800
27x	5400	5700	3200	14300
29	−2700	None	−4000	−6700
29x	27000	None	2400	29400
42x	None	−500	None	−500
43x	−300	−6200	2000	−6500
44x	500	−5900	800	−5400
45x	−1600	−3500	None	−5100
46x	−2700	−3500	−1600	−7800
47x	500	−2400	−1200	−3100
48x	5400	−1400	−1200	5400
51x	10500	−1100	−1200	10500
52x	11900	−500	−800	11900
53x	18100	None	−1200	18100
61x	20000	None	−2000	20000
62x	19500	−500	−800	19500
64	−11300	−800	3200	−12100
65	3200	None	2000	5200
66	−500	1700	2800	−3700
67	14300	3300	900	18600
68	19500	5700	None	25200
69	17600	5100	−800	22700
70	19100	6400	−2800	25500
71	17800	9200	−3300	27000
72	21900	16200	−6500	38100
72b	13200	10500	−3200	23700
73	−15700	−11900	−8400	−36000
73x	8100	5400	1200	14700
73a	11900	8900	−6000	20800
74	7600	−9700	−4000	7600
74x	2700	6800	2000	11500
74a	10800	13500	−5200	24300
75	4900	−4300	−1200	4900
75x	2400	7300	1600	11300
75a	5100	5100	−1600	10200
76	13000	−15400	−4400	13000
76x	None	6800	1600	8400
76a	12200	11100	−4400	23300
77	13200	−11300	−4800	13300
77x	800	6200	1600	8600
77a	15900	15100	−4000	31000
78	−1400	500	2800	1900
79	3800	−300	2000	5800
80	10000	−1400	1600	11600
81	15400	−2700	800	16200
82	17600	−5400	None	17600
83	17900	−6800	−800	17900
84	18100	−5400	−3200	18100
85	15400	−9700	−2400	15400
86	19000	−13300	−5600	19000
86b	10800	−9500	−4700	10800
93	−300	1900	−4400	−4700
94	−1100	1400	−5200	−6300
95	−800	1400	−4800	−5600
96	−1400	1400	−6800	−8200
97	−500	1400	−6000	−6500
98	−3900	−1600	−4300	−10300
98x	−10300	1600	3300	−10300
99	−1100	−2200	−4000	−7300
100	−3500	−1600	−4400	−9500
100x	−8600	1400	3600	−8600
101	−4000	−1900	−4000	−9900
101x	−11100	800	4800	−11100
102	−4000	−1900	−5200	−11100
102x	−10500	1600	5300	−10500
103	−4000	1400	−4800	−8900
103x	−11300	−800	4000	−12100
104	−5400	1400	−4400	−9800
104x	−9700	−800	3200	−10500
105	−2700	500	−4800	−7500
105x	−11300	−1600	6000	−12900
106	−4300	1600	−7200	−11500
106x	−11600	−500	6000	−12100

Minus = Compression.

Table IV. Stresses in Cast Steel Frame-A.

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
1	−1100	1400		
2	−4500	2400		
3	−7300	2700		
4	−8900	2400		
5	−9500	3500		
6	−7600	3800		
7	−3500	3000	−1700	−5200
8	1100	4000	−2100	5100
9	8100	1900	−1200	10000
10	11100	2200	−1200	13300
11	11600	2200	−800	13800
11x	10800	−1900	−600	10800
12	11600	2700	−800	14300
13	11100	−1900		
14	10800	2400		
15	9200	1400		
16	8600	800		
17	4600	900		
18	−8400	500	−4500	−13200
19	−5400	1600	−6000	−11400
20	−4600	1100	−7300	−11900
21	−2700	1600	−6900	−9600
22	−3500	−2200	−8900	−14600
23	3200	−1600	−2100	3200
24	7800	−1600	−1700	7800
25	9700	−2200	None	9700
26	8600	−2200		
27	11900	−4600		
28	6500	−1400		
29x	8900	None	−7000	8900
30	7600	3000	2100	12700
30x	9200	−1100	−3300	9200
31	6800	2200	2900	11900
31x	7000	−2700	−2100	7000
32	5400	3200	1200	9800
32x	8100	−3200	−1700	8100
33	6500	5900	800	13200
33x	5900	−6800	−800	5900
34	6800	7000	−500	13800
34x	5400	−6800	500	5400
35	6500	8400	−2400	14900
35x	4300	−8600	800	[illegible]
36	5100	9700	−2100	14800
36x	5100	−8600	2100	7200
37	5900	10000	−2800	15900
37x	5100	−12400	3300	8400
38	14000	None	−3300	14000
38x	12200	None	3600	15800
39	4000	−7300	−3300	−6600
39x	4900	7300	2800	15000
40	3200	−11100	−1500	[illegible]
40x	2700	9700	1700	14100
41	1400	−15900	−2700	−15200
41x	1400	15100	2900	15400
42	1100	−15100	−3300	−17300
42x	1100	14800	3300	18400
43	500	−14000	−3300	−16800
43x	300	13200	2400	13900
44	−5700	2200	−3300	−11900
44x	−8100	−1600	6200	−9700
45	−6800	−1400	−6900	−14700
45x	−5400	−1900	6600	8400
46	−7000	1100	−8100	−15100
46x	−5400	−1400	5400	9400
47	−7800	1900	−8900	−17300
47x	−7600	−800	7200	2900
48	−10000	1100	−8900	−17300
49	−7600	−1100	5900	−10000
49x	−11900	1900	−7400	−16100
50	−5900	−2200	8900	−11100
50x	−10000	2200	−6900	−13000
51	−7300	−1900	7800	−11900
51x	−9200	1900	−6700	−14700
52	−5900	−1800	7400	−9200
52x	−8400	1900	−5900	−13700
53	−5700	−2400	4500	−8400
53x	−8400	1900	−3600	−12300

Minus = Compression.

Table V. Stresses in Cast Steel Frame B.

The column in the table represents the same items as those of Table IV.

DISCUSSION OF RESULTS.

Whenever the subject of a design of a truck side frame has been discussed, the question usually has been, "What factor of safety shall we allow?" It is a well known fact that an arch bar type of side frame has a calculated factor of safety of from 12 to 16. This seemingly large factor of safety was not originally used but was arrived at by substituting larger and larger sections in an attempt to overcome breakage, and yet a great many arch bars break, and we usually say that the metal was not of the correct material. The same thing is true of the cast steel side frame. When we find a cast steel side frame broken or cracked, we lay it to the metal, while it may have been due to the design. In fact it appears that the average designing engineer has been using 25 per cent mechanical knowledge and 75 per cent judgment in the design of the different members that go to make up a freight car truck. A careful study of the results of the tests here included will, I think, show some very important factors in the design of cast steel side frames. It shows clearly that we have not been able to figure accurately the stress occurring in the different members of the frame. For instance, let us look at the stresses obtained in the tension member of the A frame at reading No. 46x and 69. Reading 46x is on the web side of the L, and reading No. 69 was taken on the top of the lower leg of the L at the front or away from the web. Now it will be seen that the stress at the reading 46x for the direct vertical load is 1,600 pounds per square inch in compression, and at the reading No. 69 is 17,600 pounds in tension. Also at the reading 8 and 8x, which were taken at the top of the L section, the 8x reading being on the back of the web and the 8 on the front, it will be seen that the 8x reading was 5,400 pounds tension, and the 8 reading 16,500 pounds, showing very plainly that the tension member is attempting to bend in such a way that the two legs come nearer to the center of gravity of the member.

Another place where the stress does not follow what we expect, is at the center and bottom of the frame at reading 29 and 29x. It will be seen that the stress at 29 is 2,700 pounds compression, and 29x is 27,000 pounds tension. If we stop to consider we can see why this is true, for the outer edge at point 29 can bend up and relieve itself, thus leaving most of the load for the web side. Now if we look at the results obtained at the same points on the tension member of the B frame where the web is in the center, we will find some variation in results, but nothing like this wide variation. For instance if we take the reading at the bottom of the B frame at 38 and 38x, we will see that the stress is 14,000 and 12,200 pounds per square inch, respectively. The average of the two would be then 13,100 pounds. Now if we should average the two stresses at points 29 and 29x on frame A, we would obtain 12,150 pounds in tension. So it will be seen that the average stress for all practical purposes is the same. It is also true that if we should figure the moment of inertia for the cross section of these two frames at this point, we would find them almost exactly the same.

The same comparison can be made at the lower end of the tension member. That is, the average stress for the direct vertical load on the A frame at points 46x, 69, 8 and 8x, is 9,200, and for the same relative point on the B frame, that is points 34, 34x, 11 and 11x, is 8,600, which is for all practical purposes the same. That is for the comparison at the bottom of the frames, the maximum stress on the A frame is 27,000 pounds per square inch, and 14,000 pounds per square inch on the B frame, and at the bottom of the tension member the maximum on the A frame is 17,600 pounds and 11,600 on the B frame. That is the maximum stress in the B frame under the vertical load is 50 per cent less in the bottom member, due to its symmetry of section, and 30 per cent at the bottom of the tension member in the B frame. This same saving is true in any comparison of the stresses due to the three loads, that is, the twisting, transverse and direct vertical loads. As it will be seen that the maximum indicated stress on the A frame is 38,100 pounds at 72, and a maximum of only 19,400 at point 41x on the B frame.

By studying column No. V in each of these tables you will see that there are a great many places where the stresses are over 20,000 in the A frame, but none where it is that high in the B frame. In fact there are only five points on the B frame where the stress is over 16,000 pounds with the three forces applied, and there are twenty-four points that show over 16,000 pounds stress on the A frame, and there are seven points on the A frame that show over 25,000 pounds stress. This would clearly indicate that the metal in the B frame was distributed in a manner that each pound of metal was doing a more uniform share of the work than is true of each pound of metal in the A frame.

The value of a small amount of metal at the correct point is well shown in Fig. 10. Here are shown two curves, one of the curves is plotted from the result obtained under the direct vertical load on frame B at the points 1 to 2 inclusive. These values are represented by circles. The other value plotted as crosses on the same ordinate are results obtained from a frame made from the same pattern as frame B, but four pounds lighter. This metal was placed as a narrow flange on the B frame, as shown at the top of section A-B, Fig. 7. This flange started gradually at point 3 and continued to point 13 where it disappeared into a small head on each side of the web. It will be seen that the maximum stress at point 11 on the B frame, was only 50 per cent that obtained on the frame without this flange which weighed four pounds less.

Another place where a small amount of metal can materially reduce the stress is at the bottom flange. The results from four frames tested of similar design except as to width of the bottom flange is given in Table VI.

The maximum stress indicated in this table was obtained by averaging the stresses at the positions on the different frames represented on the B frame at points

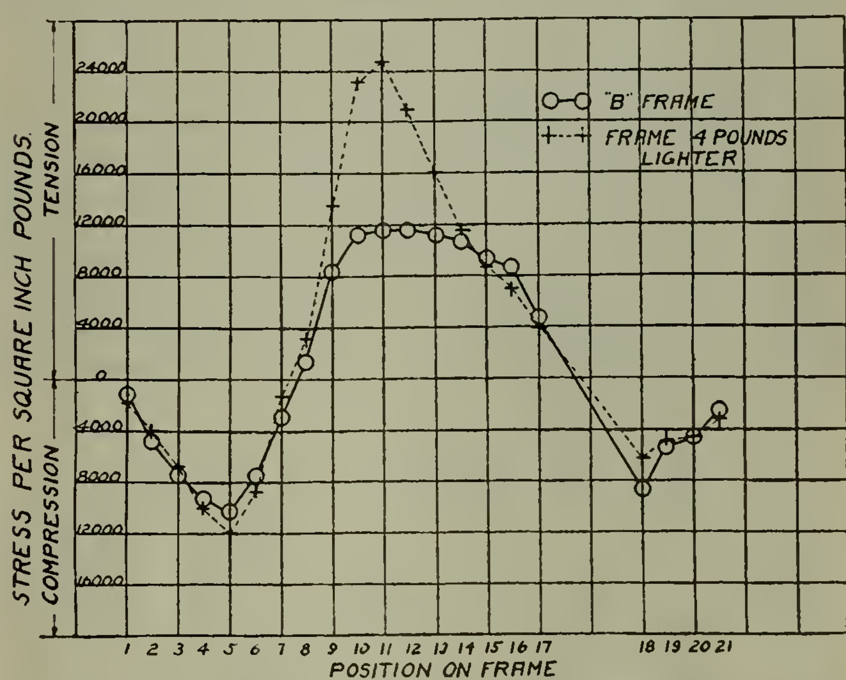


Fig. 10. Showing a Comparison of Stresses at the Different Points on Frame B and Similar Frame with 4 Pounds Less Metal.

41 and 41x, which are the weakest points on frame B under all loads.

The transverse load was not taken into consideration because of the fact that it had very little effect at this point, due to its distance from the point of application of the transverse load. The assumption was also made that the twisting force acts in both directions and the stress due to the twisting would at times be positive on both sides of the frame. It will be noted from this table that the maximum average stress will be almost inversely proportioned to the square of the widths of the bottom member.

From a survey of the results here given it may be seen that the stress is somewhat higher than some of us expected. I am sure we would be very much surprised if we should test an arch bar truck under these methods. The fact is certain that where we have been assuming that we had a low stress, and that stress of 8,000 to 10,000 pounds has been breaking frames, we will have to change our assumption and say that it will take over 20,000 pound stress to cause cast steel to fail. And I feel that cast steel will stand up under occasional stresses up to 20,000 pounds for many years.

If we stop to consider the cast steel bolster we will find that they are getting loads that produce stress of 20,000 pounds, and they are standing up. For instance a bolster which can be figured more accurately than a side frame that has a stress of 10,000 pounds under a load of 68,500 pounds, which is the load used for figuring by some companies, will often get double that load as shown from the tests recorded in the first part of the paper, and thus, you will see that 20,000 pounds stress will be produced in the bolster.

This B frame is not a heavy frame. Its weight is 435 pounds, and as the M. C. B. committee last year recommended to the Association a frame of 500 pounds for 100,000 pound cars, this B frame could be increased 65 pounds, and if the metal was well placed, the maximum stress under the three loads would not be above 15,000 pounds stress at any point. I am confident that if a cast steel frame was never subjected to a stress of over 15,000 pounds, the life would be considerably more than the life of the car.

From the results which I have obtained in the test of some forty different designs by the use of the Berry strain gage, I am confident that a cast steel side frame can be designed for any service and for any desired stress, it only remains to decide the maximum stress desired, and then place the correct amount of metal at the right place.

The use of the Berry strain gage, while very new, I am sure will become a great factor in the design of cast steel members for freight cars and other service.

I wish to acknowledge the assistance rendered by the Pennsylvania Railroad through D. F. Crawford and T. R. Cook and others of that road in furnishing a car and moving it over the lines of the Pennsylvania Railroad in order to obtain the first part of this paper. I wish also to express my appreciation to the American Steel Foundries for furnishing me all the casting and apparatus necessary in carrying on this work.

Operating Expenses, N. & W. Ry.

The Norfolk & Western has managed to reduce its ratio of operating expenses to gross to 65.78 per cent during the six months ended December 31 last, compared with 67.30 per cent in the same period of 1913. Net income was $340,916, or 6 per cent less than in the previous year. Actual loss in operating revenues was greater than the saving in expenses.

The Mechanical Department and the Public

An Address Before the Rotary Club of Shreveport, La., Which Gave Its Members a Clearer Understanding of Railroading

By W. H. Sagstetter, M. M., Kansas City Southern Ry.

Much has been said and written in the past relative to the various departments of railroads, but very seldom does the railroad man have an opportunity to express himself upon this subject to a body of men composed of almost every field of endeavor. It has always been his lot to speak or write to men of his respective class.

I firmly believe I am safe in assuming that not one business man out of every hundred reads those interesting and fascinating articles that are published regarding railroads and railroad operation in unbiased magazines, but they will devour with lustful eye the criticizing articles written in the daily press, weekly or monthly magazines by various writers who deal with railroads from the surveying of the very ground before they begin, to the maintenance and operation of the fastest and safest mode of travel now in existence. These same writers deal on many other subjects on which they are no better informed than on railroads. Many of these writers have never labored a day at any kind of work on a railroad in any department, yet their view of railroading as explained by the flourishing stroke of the pen seems to be the ideal for which the public clamor, and which we, as railroad men, know is next to impossible.

I will endeavor to explain in a small way some of the magnanimous expenses and operation of one branch of the railroad business. I will try to compare it with other industries and with our government, and see if they are not also subject to practically the same conditions that exist on the railroads of this country today, excepting legislation. I will endeavor to compare them and see if they, as a whole, are better managed, less extravagant and generally more efficient.

A railroad has two principal sources of income or revenue; first, from the compensation it receives from transportation of the public from one point to another; the second, revenue obtained from transportation of various commodities from one point to another, be it mail, express or freight.

In order to transport the public and commodities, it must possess various classes of equipment in which the public and freight may be placed and must have a source of power that will handle this equipment and do it in a safe and expeditious manner, in order that the public, who is its master, will be pleased.

To maintain this equipment is a large item—to maintain it properly is a larger one. There are approximately 65,000 locomotives in the United States, 2,300,000 freight cars and 50,000 passenger cars. All of these are subject to damage through ordinary traffic, deterioration and accident.

The following shows the cost of operating a six-car passenger train for the distance of 1,000 miles:

Cost of locomotive repairs and inspection	$111.60
Cost of handling locomotives at shops or terminals, before being delivered to engine crew	19.60
Cost of fuel	101.30
Cost of water for locomotives	5.50
Cost of lubricating locomotive and tender	2.20
Cost of miscellaneous supplies	2.90
Other expenses, chargeable to cover superintendence, wear and tear on machines, stationery, etc.	11.00
Cost of passenger car inspection and repair	63.50
Cost of cleaning passenger cars	19.90

Cost of heating and lighting	15.80
Cost of lubricating	.90
Other expenses in handling of passenger cars by shop employes	7.60
Ice and water	3.75
Wages of engineer and fireman	74.30
Wages of train crew	155.50
Cost of switching cars, building train, etc	58.00
Total cost	$653.35

This does not take into consideration supervision given by the transportation department, cost of dispatching train, or any other expense incurred by any other department of the railroad.

These expenses vary according to climatic conditions, prices of the various commodities necessary to perform the above mentioned duties, the prices paid for labor, size of the power, and the geographical conditions of the country through which the train operates. However, it is a fair estimate or average for this country.

The average period during which a locomotive is supposed to be able to produce efficient results is about fourteen months, but this varies a great deal according to the class of engine and the service which it performs. When an engine has been out of the repair shop this length of time she is again overhauled or repaired, and those parts that have been worn, broken or deteriorated are repaired and replaced with new, and the locomotive goes forth again to do such duties for which it was originally designed. The average cost of doing this class of repairs varies from $2,000 to $4,000, according to the size of the locomotive, the parts that require repairs, facilities for doing them, and wages paid to the various classes of mechanics.

"The building, inspecting and maintenance of freight cars is equally as large, if not a larger factor in the present day railroading than the locomotive.

The cars of a few years past were built completely of wood, except the trucks and necessary iron to brace them. These cars, it was found, would not stand the stress and strain which they receive in ordinary handling for any great period, and as necessity has always been the mother of invention, steel underframe cars have rapidly superseded the old type and very few railroads of today are building wooden underframe cars. It is predicted that it will only be a few years until cars with wooden sills will not be accepted with interstate freight.

The repairs to these millions of cars throughout the United States is a great item and the various roads have a system of rules by which every company that handles cars is compelled to take care of the car that belongs to the other line in just as an efficient manner as he does his own.

The average life of a wooden freight car has been estimated as sixteen years; during this time it is necessary to have the car rebuilt for general repairs, approximately, three different times, at an average cost of $150. The life of a steel car is longer and the maintenance less, due to it being more strongly constructed; however, the average cost of repairs per car mile for both wooden and steel cars is approximately five and a half mills per mile, or for a train of sixty cars, the sum of $330 for one thousand miles.

There has been a great deal of legislation passed within the past few years, some of which was nation-wide and affected all railroads, other which was only statewide and affected the railroads that operated through that state. The two principal ones were the Interstate Commerce Commission rules for inspection and maintenance of locomotive boilers and the Interstate Commerce Commission ruling for safety appliances on cars and locomotives. While these were both good laws and would, no doubt, have been put in effect by the majority of the railroads without legislation, nevertheless, they have thrown an extra burden of expense upon the railroads who are compelled to comply with them, or at least a part of them, from the date of their passage.

One railroad in this section of the country has prepared a list in which it shows the necessary expenses involved in complying with the boiler inspection rules for one year. This railroad has 394 engines and has shown a cost of $90.47 per engine per annum, or total cost of $35,645.09. To comply with the Interstate Commerce Commission laws on inspection and repairs to freight and passenger cars is as large or a larger item than the boiler inspection laws, but it is so interwoven with the other duties of the men who perform this work that it is almost impossible to obtain an actual statement as to its real cost.

I do not wish to be misunderstood or have these statements construed so that anyone will gain the impression that I condemn the two particular laws mentioned, but there could have been a great many changes made in them that would have given the railroads of this country more time to comply with them, without the enormous expenditure at the time they were least prepared to make it.

There is probably no business or industry that is criticized so unjustly as the railroads of our country. Quite frequently, there is a delay to a train due to some defect in machinery or to some natural cause over which the railroad company has no control, and the public is inconvenienced for a few hours. One can usually hear on occasions of this kind remarks passed about what should be done to the railroad and railroad officials, and if executed, would make the Hades as shown in Dante's Inferno seem like a midsummer night's dream.

There is approximately one delay for every ten thousand miles that an engine makes and sometimes they make as much as fifty thousand. This includes freight and passenger service. The average delay to a passenger train is about one train out of every one hundred delayed, an average of two hours and ten minutes. Compare this with the delays that you have on your automobile, even when it is under the supervision of an expert mechanic and kept in the best of garages. Make one hundred trips of one hundred miles each and I will venture to say you will have a delay. If not, then make five hundred trips of one hundred miles each and I will guarantee it.

It is only fair to assume that the American people are becoming more thoroughly acquainted with the railroad and its operation. In 1838 a club of young students in Ohio arranged to debate the question of railroads—at that time just coming into notice. When they asked for the use of the schoolhouse they received the following reply from the school board of the city:

"You are welcome to the schoolhouse to debate any proper question, but such things as railroads and telegraphs are impossibilities and infidelity. There is nothing in the Word of God about them. If God had designed travel at the frightful speed of fifteen miles an hour by steam He would clearly have foretold it through His holy prophets—it is a device of Satan to lead immoral souls down to hell."

While I do not desire to compare this to the public opinion today of the railroads, yet there has sprung up the past several years a general criticism of the management of railroads, some just and a great number unjust. Also a great amount of legislation against the railroads, some of which is also just and some unjust. Some of

those who have posed before the public as possessing at least one of the attributes of the Almighty—that of all-wise—have been heralded as the most gallant critics of the age. They have made statements that could not be substantiated or repudiated without the expenditure of enormous sums, and as this expenditure was not forthcoming their statements were accepted as true. One gentleman made the remark that the railroad companies of this country were losing one million dollars per day, due to inefficiency, yet he did not state what amount of money must be expended in order to make things so efficient that this million could be saved. He quoted F. W. Taylor in this statement, yet he did not state that the government was losing $600,000,000 per year on account of inefficiency in the fire department alone. He did not state that the railroads of this country were 100 to 500 per cent more efficient than the government operation. Yet he could have found this same information with just as little trouble. Mr. Harrington Emerson's essays on federal government work, printed in his book, "Efficiency," comments on the fact that in making assays of work on one of the largest government operations he found the efficiency to be 11.86 per cent. If the railroad operations were no more efficient than this, for every million dollars spent in operation, they would obtain $118,600 worth of work. The remainder, $881,400, would be wasted.

No one has ever stated that the nearest any industry or manufacturing establishment in the United States was to perfection was about 80 per cent. This, according to the experts, is the highest efficiency yet obtained and prevailed in one of the large harvesting machine manufacturing plants. The great steel industries of this country, that are know throughout the world by their enormous output and quality of goods, are considered by these same experts to be only 49 per cent efficient. These same experts tell us that our government has lost $180,000,000 in building the Panama canal by not being efficient. Is it, then, to be wondered that an institution that pays the best of salaries, supposed to have the most thorough and intelligent men in every line, can produce but 12 per cent efficiency, how we can expect the railroad companies of this country to be perfect. They can not be expected to be as efficient as a manufacturing plant. A large railroad has a number of shops or repair points scattered over the distance of thousands of miles to take care of their equipment as it is worn out in the different parts of the country. In order to expend the least possible sum on these repairs and to show the highest grade of efficiency it would be necessary to have these various repair points equipped with the most modern tools, and to expend sums that would be entirely inconsistent with the amount of revenue that the railroads now obtain. Whenever the expenditure necessary to increase efficiency is so large that the interest on it will be greater than the saving made in being efficient, it is not policy to make that expenditure.

There is a total railroad mileage in the United States of 356,418 miles, 240,339 of which is main line and 116,179 siding. If put in a straight line they would go more than fourteen times around the earth or forty-four times through it. They employ directly about 2,000,000 men and women, and support, through the wages paid, no less than one-twelfth of our entire population.

It is conceded by all large financial interests that the railroads are the barometers that indicate the business conditions of this country. Unless they are given an opportunity to make a legitimate living the entire country feels the effect.

Therefore, let me suggest that we all be reasonable and conservative, and give this, the greatest of all public service corporations, an opportunity to exist. While they, like all others, have made mistakes in the past, let us take the optimistic view and drive the gathering clouds of pessimistic legislation from the horizon of their future. They only ask that you show them the same consideration as shown other industries.

They are doing everything in their power to treat their employes and the public square; they are doing everything to eliminate danger and preserve life and limb. Let us stop the agitation and see if we cannot get the honest investor to again return to the railroad fields and you will all profit by it. By the extension of the steel ribbons into undeveloped territory, a better service, more comfortable equipment, less dangers, more magnificent buildings that will add beauty to your cities, and last, but not least, a mutual and friendly feeling."

Electrode Holders.

SAVING ELECTRODE HOLDERS

By Al Sherwood.

The illustration shows a number of burnt-out electrode holders and also new electrode holders which were devised at the Burnham shops of the Denver & Rio Grande by Charles Barber, chief electrician.

The three holders at the left illustrate the condition of holders arriving at terminals at times, generally caused by too much speed on the machines. The fourth object from the left shows the bottom half of a Pyle electrode holder which has been cut off and tapped to screw onto the holder on its right. The object on the extreme right shows the electrode holder assembled complete. It is not necessary to throw away an old electrode holder on account of the thumb screws being burned, as rings are made separate and can be applied at any time. In the event of the holder burning, only one-half need be thrown away, the upper half being replaced by the section devised by Mr. Barber. Approximately 80 per cent saving on maintenance of electrode holders is thus obtained, something worth while when we consider the number of these holders that are burned through overspeed.—*Scenic Lines Employes Magazine.*

Square Brake Shaft Design and Drop Handle Arrangement

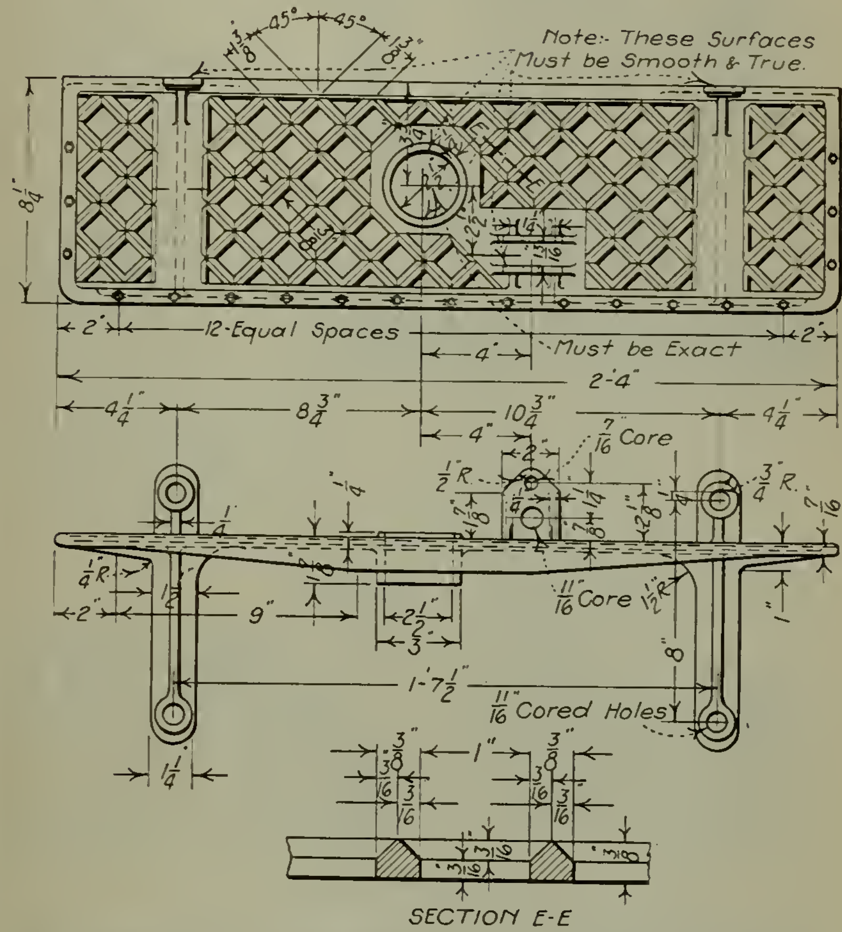
A Brake Shaft Design Whereby All Smith Work Is Avoided, and a Drop Handle. Both in Use on the B. R. & P. Ry.

Before the safety appliance law went into effect it was the practice of many railroads when manufacturing brake shafts to weld the enlarged chain drum end to the shaft proper, and for repairs, especially at points remote from the manufacturing centers of the companies, welding was almost universally followed. A few railroads which had an ample equipment of forging and upsetting machines had practiced forming the shafts by upsetting in place of welding, and in consequence their cars more nearly meet the law in this particular. Such roads find less difficulty in complying with this order than do roads not so fortunately equipped.

The manufacture of solid forged brake shafts for thousands of cars, in connection with the demand for numberless handholds, ladder rounds, etc., has fairly swamped the railroad blacksmith shops and delayed the equipping of cars to meet the safety appliance standards.

The usual design of round brake shaft and the common method of securing the ratchet wheel to the shaft by a key have been criticized for a number of years. The method of attaching the hand wheel by forging a taper square seat for the wheel and a threaded end stem with a nut and cotter to secure the wheel may also be improved and simplified.

The efforts of the designer and car builder, and the Commission's order, have done much to improve the details of the hand brake, the mounting of the shaft and the attachments. Largely, however, the design has remained fixed and the improvements are the result of more costly and rugged construction, not to a betterment or simplification of the design.

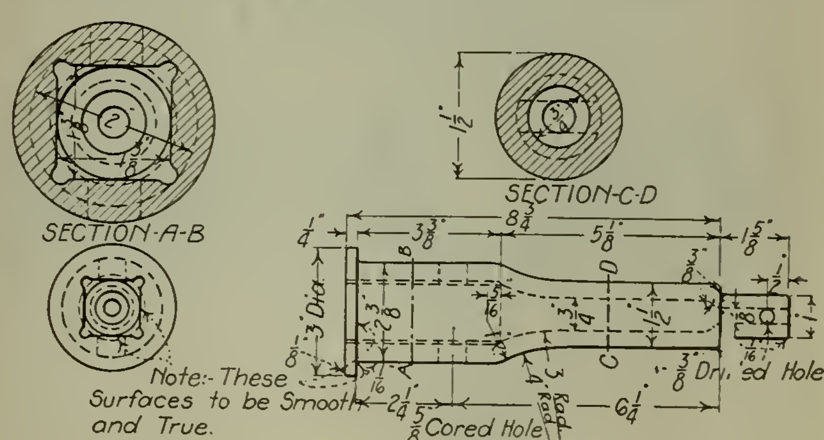


Metal Brake Step Used with Square Brake Shaft.

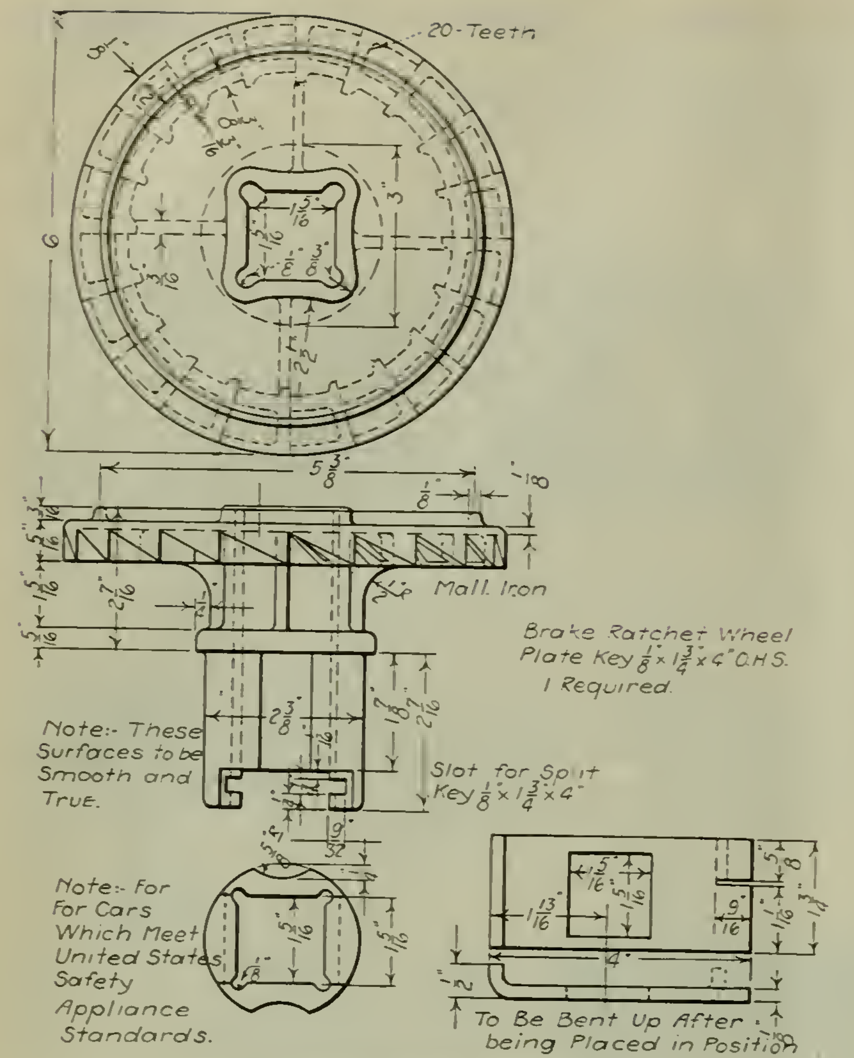
Square Brake Shaft Applied to Car.

When the Interstate Commerce rules were promulgated, the Buffalo, Rochester & Pittsburgh was one of the many roads which found that a large number of its cars had welded brake shafts. The complement of forging machines which had been sufficient for ordinary conditions was found insufficient to turn out the requisite number of hand holds and brake shafts, and it therefore became necessary to either invest in inexpensive forging machines and furnaces or to find a design of brake shaft which dispensed with the upsetting process. It was found that such an arrangement was available, but after some study it was decided that this did not go far enough and that what was wanted was an arrangement by which all smith work would be avoided.

The illustrations show the design which was evolved and which dispenses with the upsetting process. It does



Brake Shaft Drum, B. R. & P. Ry.

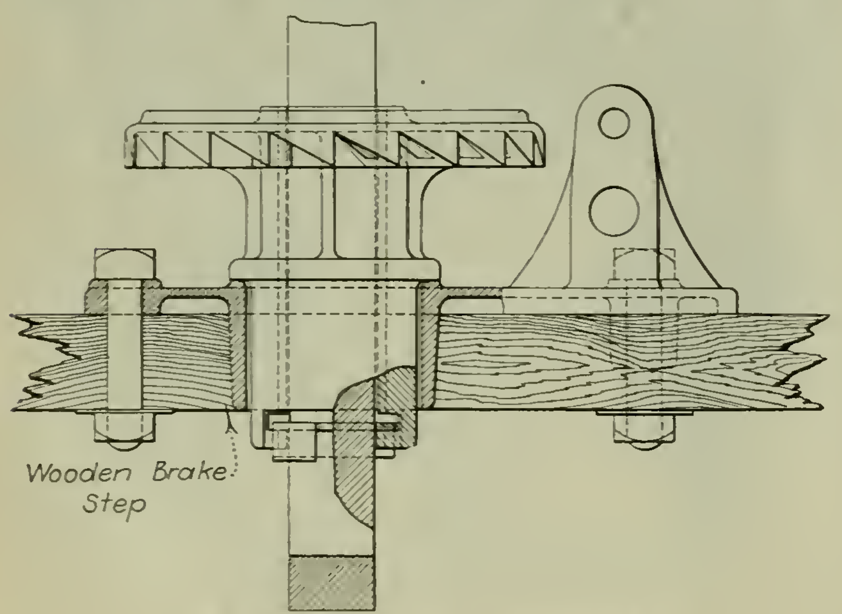


Brake Ratchet Wheel.

away with the forging down at the end of the shaft below the drum, renders unnecessary forging a taper square and the round end (and threading the end for the brake wheel), dispenses with the key-way and troublesome key to secure the ratchet wheel and in fact eliminates all heating, forging and skilled labor. It provides a design of greater strength and simplicity, one which is so elastic that the work of equipping cars may go forward at any point on the line of the road where forging machines are not located, and indeed where there are no blacksmiths.

The brake is applied to box cars, to steel hopper cars and to gondola cars. In the first two mentioned, cast metal brake steps are used, and with these, independent metal pawl plates are unnecessary. For the gondola cars, wooden brake steps are used, in which case a special metal pawl plate is required.

The brake shaft is a plain square bar of iron or or steel, without forge manipulation of any character, two bolt holes only being required, one near each end. The one at the lower end of the shaft serves to engage the brake shaft drum. The same bolt also answers to secure the brake chain. The bolt near the upper end of the shaft engages the brake wheel.

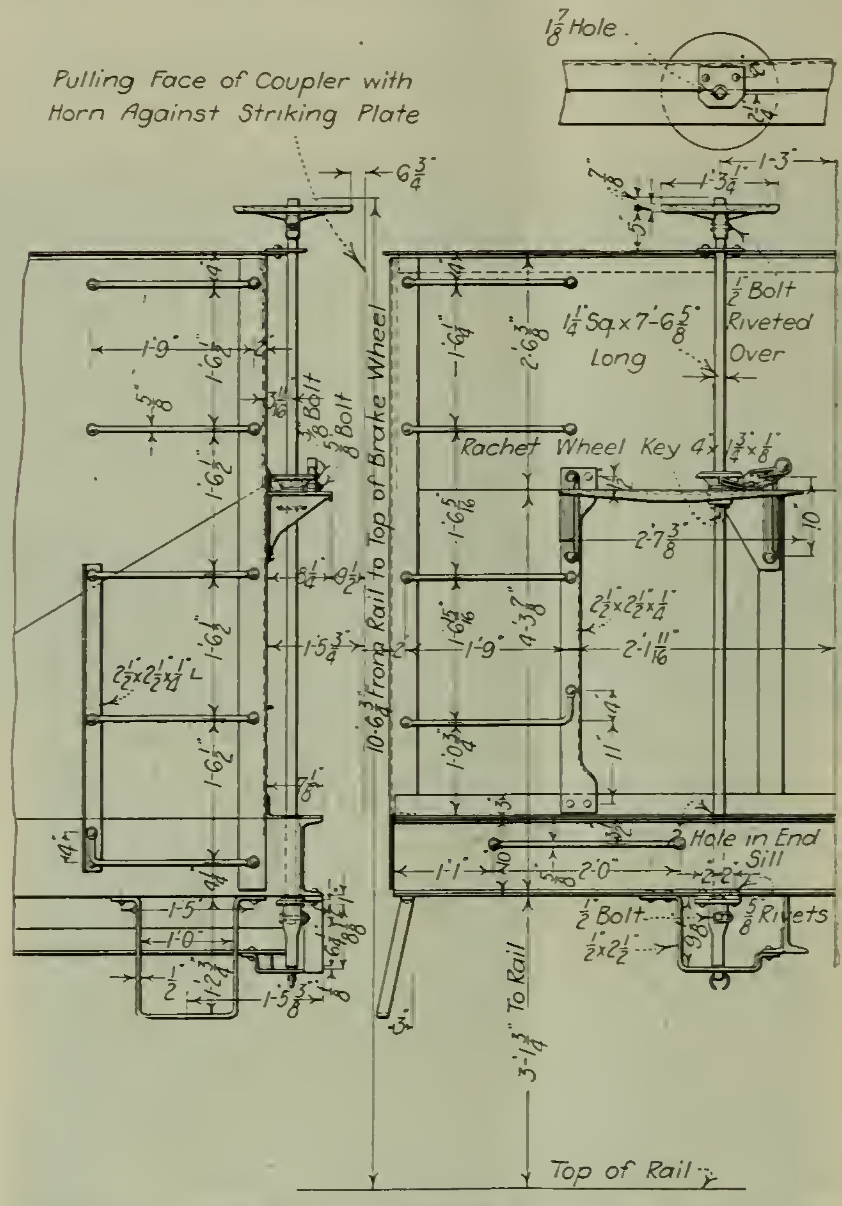


Pawl Plate Used on Wooden Brake Steps.

The brake drum is made in two diameters, the upper and larger portion serving as a quick take-up for the slack of the brake chain, and when actual tightening of the brake takes place the chain is on the smaller diameter so that the efficiency of the brake is not impaired.

The hand wheel has a special long hub. The lower part of the perforation for the brake shaft is square, with parallel sides to serve when it is used with the plain square shaft. The upper part of the perforation is also square but tapered and is suitable to engage brake shafts having the regulation tapered end. By the use of this combination wheel, one pattern answers for either the plain square shaft or the regular tapered end shaft.

The ratchet wheel is formed with an extended bearing or trunnion below the toothed disc. The trunnion fits into and through the opening provided in the brake step



Square Brake Shaft Applied to 100,000 lbs. Capacity Hopper Car.

or brake pawl plate and a key is inserted in the groove cast in the trunnion to prevent removal of the ratchet wheel when once placed in position. On account of the square section of the shaft and corresponding form of aperture in the ratchet wheel, any movement of the brake shaft is communicated to the ratchet wheel, but the ratchet wheel is not directly fixed to the shaft. Therefore the ratchet wheel and brake step may be assembled and placed in position upon the car independently of the brake shaft. This is also true of the intermediate bearing and support used on the end of the box car. The

shaft slides freely through the bearing, the ratchet and key and into the drum. Applying or removing the one bolt through the brake drum secures or permits the removal of the brake shaft.

The illustrations show the ratchet wheel with the engaging teeth on the lower face of the disc, the pawl being of the gravity type. If it is desired the teeth may be made on the periphery of the disc instead.

The castings require no machining and are ready for assembling as received from the foundry. Experienced and skilled labor is not required to assemble and equip the cars.

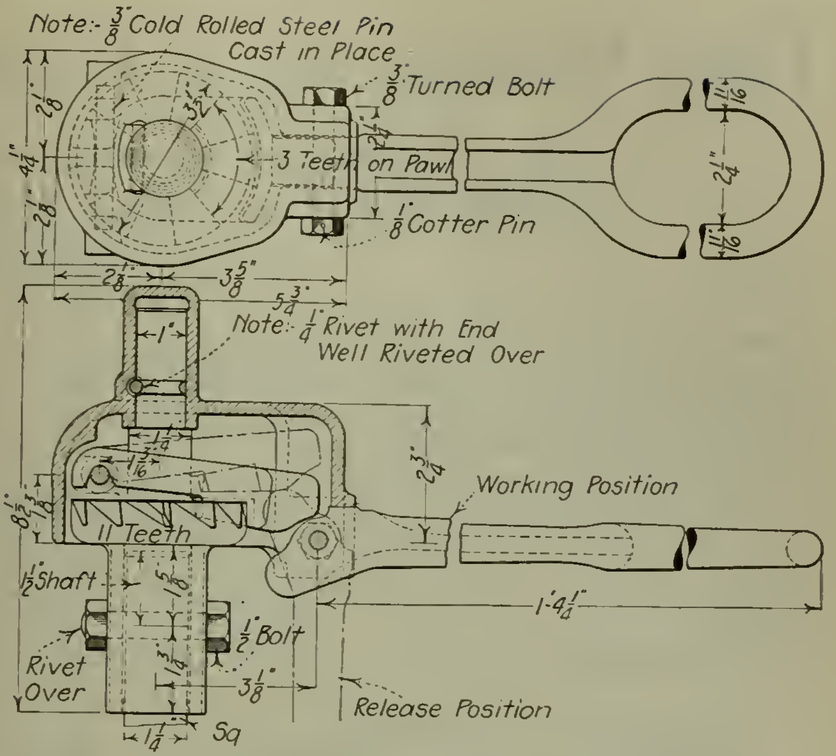
This hand brake has been applied to a large number of cars and has proven very satisfactory. The arrangement has been patented by F. J. Harrison, superintendent of motive power, and William J. Knox, mechanical engineer, of the Buffalo, Rochester & Pittsburgh.

BRAKE RATCHET WITH DROP HANDLE.

A brake ratchet with a drop handle for use on drop end gondola cars, cabooses, etc., where a hand wheel is objectionable, and for cars of extreme carrying capacity where it is desirable to have greater leverage than is afforded by the ordinary brake wheel, has also been designed and patented by Messrs. Harrison and Knox.

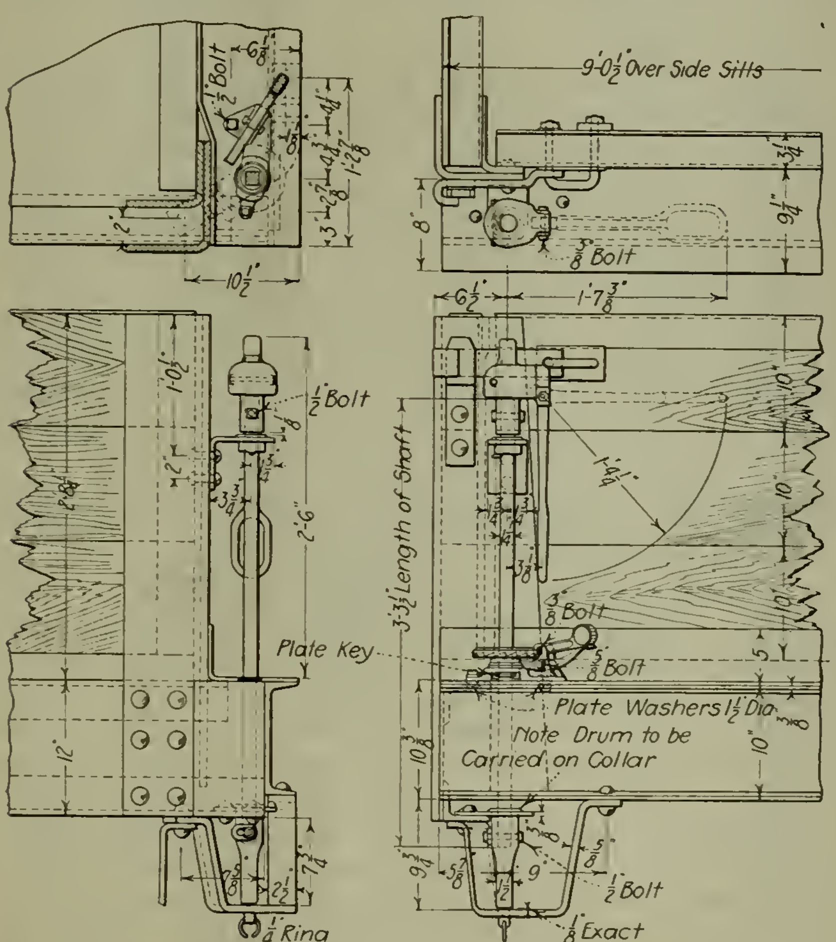
The device is shown as applied to a drop end gondola car and the details of construction are fully disclosed in the illustrations.

The ratchet is formed with a socket below the toothed disc and with a spindle above the disc. The socket fits the end of the brake shaft, a horizontal bolt serving to securely hold the casting to the shaft. The spindle above the disc serves as a support and bearing for the housing. The housing may be freely revolved but is locked against vertical movement by the riveted pin. The pawl straddles the spindle and is pivoted upon a pin. The pawl has a tongue which is encompassed and guided in the jaw formed as a part of the housing. This jaw also serves to receive the drop lever. When the lever is in the horizontal or working position the pawl assumes the position shown by the full lines and the teeth formed upon the under side of the pawl engage the teeth of the ratchet wheel. When the lever moves from working to release position it contacts with the tongue on the pawl, causing the pawl to rotate upward with the pin for an axis and the teeth are disengaged. The cam end of the lever and the tongue are so formed that when the lever is swung about half way from the vertical to the horizontal line contact between pawl and lever cease and the teeth then fully engage. This is considered important, for should power be exerted to set the brake before the lever reaches the horizontal position the teeth, as explained, are in full mesh. Forming the lever with a loop for the hand safeguards the operator in case his grip should slip, and is an improvement over the usual straight handle.



Drop Handle Brake Ratchet.

There are but four simple castings, having a total weight of about 15 pounds. The design is exceedingly simple and in service is proving efficient and reliable.



Showing Application of Drop Handle Brake Shaft.

Tunneling Record Broken

American tunneling records were broken in January on the headings for the Rogers Pass tunnel of the Canadian Pacific Railway, for which Foley Brothers, Welch & Stewart are the contractors. The following is the footage made in the month of January: East and center heading, 443 feet in chist and quartzite; east end pioneer heading, 594 feet in chist and quartzite; west end center heading, 701 feet in slate and quartzite; west end pioneer heading, 932 feet in slate. The latter is 122 feet greater than the previous American record established in the Mount Royal tunnel of the Canadian Northern Railway, and will probably stand for some time. R. C. Dennis is superintendent for the contractors.

Swinging on Trains

"Swinging on" trains after they have been set in motion is discouraged by the Baltimore and Ohio Railroad in a circular which has been issued to trainmen, urging them to get aboard promptly and before starting at terminals, in order to minimize the danger of personal injury as well as to facilitate operation and overcome delays. It is held by the company's officials that boarding trains promptly makes it possible to attain the maximum speed provided by the schedule with more quickness, while it also obviates the necessity of the engineer dividing his attention in order not to leave other members of the crew. This latest effort in the interest of quick transportation applies chiefly to freight service.

The Value of a Locomotive in Service*

The Earning Capacity of a Locomotive and How the Time Spent in Doing Useful Work Can Be Increased

By G. S. Goodwin, M. E., C. R. I. & P. Ry.

Consideration of the potential value of locomotives, expressed even roughly in terms of average daily earning capacity, suggests several important possibilities for improvement of general practice, which it is the purpose of this paper to discuss. For the fiscal year ending June 30, 1913, the total operating revenue from 251,277 miles of railroad was $3,181,177,898, divided as follows:

Freight	$2,203,860,284	69.28%
Passenger	716,174,021	22.51%
Other transportation revenue	224,939,393	7.07%
Total revenue from transportation	$3,144,973,698	98.86¾
Non-transportation revenue	36,204,200	1.14%
Total operating revenue	$3,181,177,898	100.00%

This revenue was produced by the use of 63,198 locomotives having an average tractive power slightly over 30,000 lbs. Assuming that 11% of these locomotives are in the shop receiving repairs, this leaves 56,246 as earning the above revenue. Dividing the total revenue from transportation, namely, $3,145,000,000 in round figures, by the number of engines gives nearly $56,000 per year, or $153 per day as the gross earnings of an engine. Applying to this figure the operating ratio, 71.33, we have $44 per day as the net earning power of the locomotives of the United States. This money was earned after the locomotive had paid for repairing the track, paid for repairing the cars, and paid for repairing itself.

The most notable thing about these figures is that nearly 99% of the total operating revenue of the railways is received from the operation of trains and for the successful operation of which three essentials are necessary, namely:

1st. Locomotives to move the trains, which is the subject of this paper.

2nd. Equipment to carry the tonnage.

3rd. Track to move the trains on.

No two essentials are of any benefit without the third, and the importance of all three is shown by the fact that for the fiscal year ending June 30, 1913, $544,000,000 was spent for maintenance of equipment and $538,000,000 was spent for maintenance of way.

In order to bring out the monetary value of a locomotive a little clearer, statistics are quoted from a number of the larger roads of the Middle and Western states for the fiscal year ending June 30, 1913. This table shows mileage, total number of engines, and these subdivided to show engines in freight and mixed service, passenger service, and switching and transfer service; total operating revenue from transportation, freight revenue, gross earnings of a locomotive per day, and average rate per ton mile in mills.

The separation of the engines under freight, passenger and switching heads is based upon replies received in answer to an inquiry made to the different roads. The gross earnings of locomotives per day is the quotient of earnings by the number of locomotives reduced to a per diem basis. The net earnings are obtained by the use of the operating ratio. These earnings are shown under four captions, it being assumed where noted that 11% of the locomotives are always in the shop undergoing repairs, and where switching engines are involved that 90% only are handling freight.

These figures bring out that the net average earning power of a locomotive varies from $30 to $125 per day, and that for all the roads of the United States these figures are $44 as representing the value of a locomotive. The average rate per net ton mile is introduced to show one reason why the value of a locomotive fluctuates—a locomotive capable of earning $75 per day on one road may be able to earn only $40 per day on some other road, and this is further affected by the size of the engine, amount of work for it to do, etc.

The value placed on a locomotive when rented of course varies on different roads, both as to amount and basis of computing. (Invariably running repairs are taken care of by the borrower, and general repairs by the lender.) Some use the size of cylinder, others weight on drivers or total tractive power. The general minimum charge is $10 per day, increasing to from $25 to $40 for the modern engine. Two roads base the rental on a fixed charge per 1,000 lbs. tractive effort. These on a basis of 50c per 1,000 lbs. would be as follows for engines 10,000 to 50,000 lbs. tractive effort:

RENTAL PER DAY AT 50 CENTS PER 1,000 LBS. TRACTIVE EFFORT.

Tractive Power.	Rental per Day.
10,000 lbs.	$ 5.00
20,000 lbs.	10.00
30,000 lbs.	15.00
40,000 lbs.	20.00
50,000 lbs.	25.00

Five roads based their rental charges on the result of figuring interest and depreciation on the value of the locomotive in question. To this is added charges for general repair, taxes, insurance, and profit on transaction. An example of this with the profit omitted will show what might be termed "out-of-pocket" value of a locomotive.

The following table shows approximately what this would amount to for different original costs between $10,000 and $30,000 with assumed charges for interest, depreciation, taxes, etc., and repairs. In a case of repairs, these are based on the assumption that one hundred miles represent a day's work for a locomotive.

RENTAL PER DAY, BASED ON INTEREST, DEPRECIATION, TAXES, INSURANCE AND REPAIRS.

Original Cost	Interest @ 5%	Depreciation @ 5%	Taxes & Insurance @ $1.09 per $100	Repairs Basis 100 Miles per Day	Total
$10,000	$1.37	$1.37	$0.30	$ 7.00	$10.04
15,000	2.06	2.06	.45	8.00	12.57
20,000	2.74	2.74	.60	9.00	15.08
25,000	3.43	3.43	.75	10.00	17.61
30,000	4.11	4.11	.90	11.00	20.12

Of the four methods, namely, size of cylinder, weight on drivers, rate per 1,000 lbs. tractive force and interest and depreciation method, used, the last two are more accurate, and the third is more attractive from the standpoint of simplicity. One must admit, however, that the

*A paper presented before the Western Railway Club.

last discriminates between the modern, highly efficient engine and the older engine which is less efficient. The modern engine with the latest devices to give more economical performance certainly is worth more than the same size engine built ten or even five years ago.

We have thus developed three measures of the value of a locomotive:

1st. What it can actually earn.

2nd. What it is worth from an investment standpoint, or what might be termed the "out-of-pocket" value.

3rd. What it is usually rented for.

We have also shown that 99% of the total operating revenue is produced by these locomotives while moving trains. This brings us to another phase of the problem.

An engine only earns money while it is moving freight, and is unproductive when not working. In order to bring out forcibly the actual miles an engine makes per day, I have taken from the reports of the Interstate Commerce Commission for a few roads data as to freight revenue miles and ascertained the miles per day an engine makes. These are of course approximate, but since all are taken the same way, the results are fair to all. To say the least the results are startling and were it not that the sources of information are unquestionable it would sound very reasonable to argue that an average of 57 miles per day or 4 hours at 14 miles per hour was ridiculous.

Letter	Revenue Freight Loco. Miles	Net Revenue Tons per Train	Freight Engines	Miles per Day
B	19,130,297	484	901	58.0
C	9,227,032	485	347	72.8
D	3,185,285	450	207	42.3
E	23,314,755	347	1,262	50.8
F	17,499,490	348	1,047	45.9
G	17,289,762	295–354	775	61.2
H	4,655,518	276	235	54.3
I	3,796,658	483	161	64.5
J	3,905,542	590	263	40.7
K	8,862,256	844	413	58.8
L	6,134,142	305	360	46.7
M	3,012,391	743	133	62.0
N	12,120,741	635	799	41.6
O	18,463,175	407	803	62.9
P	11,606,651	706	408	78.1
Q	8,724,526	469	348	68.6
R	7,683,123	243	404	52.0
S	14,606,645	432–317	767	52.2
T, U	7,216,128	439	317	62.4
V	12,327,770	542	746	45.9
W	5,557,633	230	230	66.1
X	14,749,266	442–500–448	877	46.2
Y	9,896,684	395	422	64.4
Total 24 roads	252,965,470		12,215	57.0

On the road with which I am connected a study has been made of just how a freight locomotive day is spent and a form of report has been developed under the direction of N. D. Ballentine, assistant to the 2nd vice president, which accounts for every movement of the locomotive during the day. Reports are made independently by the round house foreman, yardmaster and train conductor and these are combined with the information regarding engines in the shop into a single report which is summarized for the month something as below. This report was described in an address made by Mr. Ballentine before the Rock Island Railway Club and later printed in the July number of the Rock Island Employes Magazine. (In comparing this data with other lines great care should be taken to know on just what basis their data is prepared, and unless the information is developed from a similar record as described above, its accuracy may be open to serious question.)

FREIGHT LOCOMOTIVES—MECHANICAL DEPARTMENT CARE.

	Hours	Minutes	
Roundhouse	6	49	28.40%
Running repairs	2	41	11.18%
Classified repairs	3	27	14.38%
Total Mechl. Dept.	12	57	53.96%

TERMINAL DETENTION.

	Hours	Minutes	
Regular schedule	2	55	
Stock, fruit, vegetables	0	7	
Superior trains	0	3	
Insufficient tonnage	0	20	
Main line obst.	..	..	
Rest for crews	0	7	
Miscellaneous	0	14	
Time between call and departure	0	16	
Total term'l detention	4	2	16.80%

TIME BETWEEN TERMINALS.

	Hours	Minutes	
Actual running time	4	16	17.78%
Meeting trains	0	53	(Miles per
Station work	1	20	day 68)
Track conditions	0	1	
Sixteen hour law	0	1	
Accidents, etc.	0	1	
Block signals	0	2	
Engine failures	0	2	
Car failures	0	3	
Weather conditions	..	..	
Miscellaneous	0	22	
Total time between terminals	7	1	29.24%
Total time accounted for	24	0	100.00%

This brings out clearly the following points:

	Hours	Minutes	
An engine is in the hands of the mechanical department being made ready to move tonnage.	12	57	53.9%
An engine is in the hands of the transportation department ready to move tonnage	6	47	28.3%
An engine is actually moving tonnage and therefore earning money, only	4	16	217.8%

This brings us to the third division of this paper, viz., What can be done to make the engine more available for handling tonnage? This same thought is very aptly stated by George R. Henderson quoted in Baldwin Record of Recent Construction, No. 60. Mr. Henderson stated as follows:

"The author believes in wearing out locomotives as fast as possible. By this he does not mean wearing them out by improper treatment or careless maintenance, but by the legitimate work of hauling trains. The faster they can be worn out the sooner they will be replaced with modern machines, and the strides made in the power and type of locomotives in the last few years have been such that an engine only 10 years old is of comparatively little use, except for branch service. It is very much better if it be possible so to operate the road to have, say, 50 engines which must be replaced in 10 years, than have 100

stay in service for 20 years. This is what is meant by wearing them out as fast as possible, so as to reap the benefits of new and improved forms."

In discussing this problem I do not wish to be understood as taking the position that this feature has been neglected in the past. When one considers that the size of engines has practically doubled in the last 20 or 25 years, while the improvement in shop and roundhouse facilities has by no means kept pace, the performance is a tribute to the mechanical officers.

In the example of distribution of a locomotive day, the roundhouse is charged with 6 hours and 49 minutes or 28.4% of the day. This time is taken up in knocking out fire, putting in the house inspection and repairs, washing boiler, wiping, building fire, etc., and either as the engine comes in or goes out it is coaled and washed. There are several items in connection with this work which suggest themselves as opportunities to reduce the time, for instance, we have changed the dump grates in a number of engines so that the clinkers could be gotten out easier. Poor ash pan design may easily become a vital factor in cleaning the fire. Then there is the turn-table, is it up to date or when cold weather comes on does it get out of commission and require every laborer around the plant to help turn it, and then only at a snail's pace.

When the engine is in the house a big factor in increasing the availability of an engine to handle tonnage is the hot water wash out system. This is universally recognized by all and some of us have quite complete records as to just what saving the hot water washout system effects in boiler maintenance. It is the feature of boiler maintenance or rather the lack of boiler failures on the road that we are particularly concerned about in this connection.

Good inspection is another item which if watched closely is bound to save failures on the road. Some lines have what is termed an inspection pit where an engine receives a thorough inspection. Sometimes the inspectors carry a supply of nuts and cotters so as to at once replace any of those missing. This pit is particularly handy where an engine is being given a quick turn and not time to put it on a roundhouse pit.

Other features which might be mentioned are: Enough men in the roundhouse to do the work when needed. The old adage: "A stitch in time saves nine," is just as true in the roundhouse as in the tailor shop. Good facilities for doing the work, which should include a small machine shop adjacent to the roundhouse, equipped with drill press, shaper, lathe, bolt cutter and emery wheel, also a small, well-equipped tool room. This machine shop saves a lot of time running back and forth from the big shop. There ought also to be good air and steam pressure.

Running repairs is charged with 2 hours, 41 minutes, or 11.2% of the day. Running repairs no doubt vary closely with the time an engine has been out of shop, and with the thought in mind of reducing the running repairs the road with which I am connected have reduced the mileage between shoppings. There have also been put into effect some changes in detail design, which in many cases eliminate entirely the running repairs. For instance, we cast a brass nub liner on the face of driving box. The result is that it is unnecessary to drop wheels between general repairs, and there is saved the cost of this work, which conservatively is $25.00 for labor and material, and engine out of service 3 days at $44.00 per day, or $132.00. A lesser saving as regards running repairs is made by the use of brass shoe and wedge liners on the driving box. The good effect of these comes out plainest during general repairs. We find them with the tool marks hardly worn out and it is therefore unnecessary to line up and place the shoe and wedge.

Another source of trouble is pounding of main driving boxes with its attending trouble in the rod brasses. This means dropping of wheels to repair brasses. It would seem that this work could be greatly minimized by the use of some form of removable brass, although we have no experience with these devices; we have, however, used the so-called long driving box with the result that the trouble was entirely eliminated, together with the advantages of the lesser bearing pressure and reduced wear on axle. The cost to drop a pair of wheels and to crown the brass is approximately as follows: $23.00 labor and engine out of service 3 days.

To minimize stay bolt trouble the practice of using same form of flexible stay throughout the breaking zone is a great aid. One of our boiler foremen estimated this alone to save one or two days every 60-day period.

With the advent of the gas and electric welding outfits it has been possible to make many repairs that heretofore would not have been possible. For instance, to cite an actual case on our line, we had a Mikado engine with all driving wheels having flat spots two to five inches long and one-eighth to one-fourth inches deep. To have dropped the wheels would have cost not less than $150.00, which includes the loss in tire material. To this must be added the value of the engine while out of service three or four days. We welded the flat spots with an electric torch, wheels being in place under the engine in five hours at a cost of $2.05 for labor and $5.00 for material and current. Both the gas and electric torch have been used successfully in this work. This is only a single example of what this device offers in the way of getting an engine into service promptly and at the same time at a greatly reduced cost of repairs. It should be an easy matter on the above showing alone for any railroad to justify the purchase of these outfits. Forty-four dollars saved for an engine day is interest at 5% on $880.00 per annum, or save 20 engines one day you save $880.00.

All roads have some form of report showing failure of engine parts. On our line this is tabulated under the different detail parts in a monthly report which shows the nature of the failure and the numbers of the engines making the failure. This is watched closely and when any particular class of engine shows repeated weakness in any particular detail, we go into that with a view to correct the design and overcome the trouble. Another thing insisted on by our general mechanical superintendent and which puts the man actively in touch with all phases of maintenance, is that the mechanical engineer spend at least one week of each month on the road.

After the engine has made its mileage it, of course, gets a general overhauling, and whenever possible we make our engine candidates for shop pull a train to the point of shopping. If it be assumed that an engine receives general repairs every 18 months and that 60 days is the average time from out of service to in service, that means that 11% of the engines are always in the shop. Sixty days multiplied by $44.00 equals $2,640.00, the loss while engine is at the shop. Every one knows there are ups and downs in traffic movement and during slack business when locomotives are not needed to move trains, it is obvious that we should put them through the shop to the extent that they are ready for the shop and that the shop can take care of them.

While it is desirable to have a few engines in the bone yard, so that "lights" and "heavies" can be properly sandwiched in, there can be a saving made by not having too many engines standing around idle waiting to get

into the shop, but rather schedule their movement to the shop so that they are available with the least waste of engine time. An ideal condition would be more nearly realized when the condition of the engines slated to go to shop were such that one or two months in service, if necessary to suit the convenience of the shop, would not mean a series of failures.

When an engine is about to go to shop, many roads (ours among them) make a practice of sending advance notice to the shop of just what material will be needed. On firebox work 30 days advance notice is desirable, so that box will be ready to put in as soon as the old box can be cut out. To make the most of this plan of advance notice, the information must be accurate and be acted upon promptly, without waiting to get the engine in the yard to see if the material is *really* needed.

After the engine reaches the shop what improvements can be made there with a view to cutting down the time in the shop? The first thought is modern shop facilities, and, considering that an engine is worth $44.00 per day, it ought not to be difficult for any one to show substantial savings by the use of more modern shops. Assume a shop turning out 30 engines a month, or 360 per year, and that by making certain changes an engine could be turned out four days sooner. Assume further that for 3 months of the year there is sufficient business to provide work for these engines just as soon as they are turned out. The saving then will be 90 engines multiplied by 4 days, or 360 engine days, which at $44.00 per day equals $15,840.00. Now, if we have taken this $16,000.00 and purchased an engine with it, we would have had the same amount of available power, since by changing the shop we saved 360 engine days; but the more modern shop will enable repairs to be made more cheaply, and, further, the capacity of the shop is increased 6.7%. Hence, it would be considerably more economical to modernize the shop. Of course, if this improvement can be made at less than the above the saving is increased proportionately.

Another item which I understand some roads have to contend with is material. An engine is delayed for want of proper repair material, and this delay in some cases runs into months. It must not be understood that this is entirely the fault of the store department, as many times the material was not ordered as promptly as it might have been. On the other hand, the shop man has a perfect right to assume that certain kinds of material are kept in stock continuously by the stores.

When one considers that the average engine is worth $44.00 per day, it is a simple problem to figure out what lack of material means in engine delays. A great deal of this material for which engines are delayed is very moderate priced, so that no great valuation is involved, and, further, practically all material is common to several engines, particularly where there are a number of engines in a class, and this reduces the amount of stock necessary to carry in order to adequately protect the engine against delay. Too often the fact seems to be lost sight of that an engine is worth money, and the fact only is seen that there is so much money invested in stock, without regard to whether the equipment can be repaired promptly. This policy cannot be too strongly condemned, since both the mechanical and stores departments are working to the same end, i. e., to keep the engines in condition to earn revenue for the railroad. The question of suitable stock is a big one, and should be gone into carefully on each item by the store and mechanical departments jointly, since the mechanical departments are better able to say what is the probable need for the different items of stock.

While this paper has dealt particularly with what improvements the mechanical department can make in the engine performance, the study of the locomotive shows a remarkable opportunity for all concerned to aid in this work by co-operation. This includes all departments having anything to do with the movement of trains or the equipment necessary for the movement of trains.

In conclusion, I have shown that the net earning capacity of a locomotive, taking the entire country over, is about $44.00 per day, and I have presented figures based on 24 representative roads, east and west, showing that the average freight mileage made per day is only 57.0, and that the rest of the day the engine is not earning any revenue. I have followed this up by a few suggestions as to how this time standing idle might be reduced, and it is this latter phase of the question which is now before you for discussion. If it be decided that these or other suggestions which will be brought out are effective in making the engine more efficient, then we will, having put these suggestions into force, be doing our share in making a little more perfect the performance of that grandest of machines—the locomotive.

Executive Committee Meeting

The C. J. C. I. & C. F. Association Favors the Establishment of an Inspection Bureau. No Changes in the M. C. B. Rules Recommended

A meeting of the executive committee of the Chief Joint Car Inspectors' and Car Foremen's Association was held at the Hotel La Salle, Chicago, Ill., on February 24, 1915. The following officers of the association and members of the executive committee were present: F. H. Hanson, A. M. C. B., New York Central R. R., Cleveland, O.; S. Skidmore, Fmn. Car Dept., C., C., C. & St. L. Ry., Cincinnati, O.; F. C. Schultz, Chief Interchange Inspector, Chicago; W. J. Stoll, Chief Interchange Inspector, Toledo, O.; J. P. Carney, Gen'l Car Ins., M. C. R. R., Detroit, Mich.; W. R. McMunn, Gen'l Car Ins., N. Y. C. R. R., Albany, N. Y.; C. J. Stroke, A. G. F., N. Y. C. R. R., Buffalo, N. Y.; J. J. Devanney, F. C. D., T. R. R. A., St. Louis, Mo.

The following representative members of the car departments of various roads, together with a number of visitors, were present:

Bert J. Abbott,
John Allwardt,
H. Boutet,
Valantine Baltz,
W. F. Borck,
J. E. Benton,
W. H. Bettcher,
George Briden,
M. E. Bundy,
Otto Bender,
A. L. Ciliske,
J. O. Callahan,
H. E. Creer,
C. H. Carey,
W. K. Carr,
J. P. Carney,
E. R. Campbell,
T. W. Damarest,
J. T. Downs,
J. H. Douglas,
J. Dyer,
B. L. Doores,
J. J. Devanney,
A. C. Ebert,
H. H. Estrup,
H. L. Ebert,
F. A. Eyman,
G. W. Isaac,
R. R. Jones,
H. Krush,
P. M. Kilroy,
C. W. Knoerzer,
George Lynch,
A. LaMar,
A. R. McMunn,
J. R. Mitchell,
S. Mann,
F. W. Moses,
C. Nordquist,
N. Nightingale,
R. J. Nieskeus,
R. H. Niehauz,
J. S. Naery,
T. J. O'Donnell,
C. E. Oliver,
H. L. Osman,
C. W. Owsley,
A. K. Plummer,
H. G. Powell,
E. Pendleton,
A. F. Petenon,
H. W. Paul,
L. H. Retan,
J. G. Raushenberger,

W. F. Frier,	C. V. Ratcliff,
F. L. Fox,	S. R. Robinson,
J. Funk,	S. Skidmore,
M. E. Fitzgerald,	A. E. Schultz,
J. J. Gainey,	F. C. Schultz,
W. M. Govert,	C. J. Stroke,
N. H. Graul,	W. J. Schlacks,
J. Godfrey,	O. Swanson,
J. L. Howell,	A. Singleton,
E. H. Hall,	W. J. Stoll,
F. H. Hanson,	F. W. Trapnell,
R. R. Hawk,	E. H. Wirtsckoreck,
M. W. Halbert,	C. J. Wymer,
H. Holze,	W. G. Wallace,
A. M. Hilborn,	L. S. Wright,
H. Halvorson,	Wm. Westall,
A. Herbster,	C. Zorn,
W. Hogarth,	A. Ziebold.

The meeting was called to order by Chairman Schultz at 10:30 a. m., and was followed by a very lengthy discussion on the advisability of recommending changes in the M. C. B. Rules, which continued until adjournment for luncheon was taken. During the session William T. Dabney, representing the chamber of commerce of the City of Richmond, Va., extended an invitation on behalf of that city to the association to hold the 1915 convention in that city. The question was referred by the chairman to the executive committee for their consideration.

The afternoon session was called to order at 2:15. The executive committee reported they had decided to accept the invitation of the city of Richmond to hold the next convention there on September 14th, 15th and 16th, of this year.

The president appointed a committee to prepare a resolution on the death of Sam C. Howe, who passed away very suddenly on February 2, 1915; this memorial to be incorporated in the records of the meeting, a copy sent to the *Railway Master Mechanic,* and also to the bereaved family. George Lynch, C. J. Stroke and J. P. Carney were appointed members of the committee.

A long discussion followed relative to changes to be proposed in the M. C. B. Rules, at which time T. W. Damarest, superintendent of motive power, Pennsylvania Lines, was called on for remarks, and very kindly responded with information that was of great benefit to those present. After considerable discussion, the question as to whether or not this association should recommend any changes in the M. C. B. Rules, was proposed, and it was decided that inasmuch as the rules have only been in effect about six months, and it being felt that as a whole they were working out very satisfactorily, it was recommended and referred to the executive committee, that they vote that no changes be recommended at this time. The executive committee voted unanimously in not recommending any changes.

Mr. Schultz then surrendered the chair to President Hanson and during the ensuing discussion of A. R. A. Rule 15, the following resolution was adopted:

Resolved: That if repairs to a car under load cannot be made in 24 hours (as per MCB Rule No. 107, transfer order to be allowed—absence of material to be no excuse.

The following amendment was proposed and carried:

Resolved: That if repair to a car under load cannot be made in 24 hours (as per MCB Rule No. 107) transfer order to be allowed—absence of material to be no excuse *and on cars containing so-called "non transferable" commodities no transfer order should be given if it is possible to make repairs under load.*

Both motions were put to vote of the association and were carried.

The president called the attention of the members to the fact he felt that there was not sufficient interest being taken in regard to increasing the membership, after which the following motion was made and carried:

Resolved: That the secretary be instructed to get in touch with each member and request that they try to get at least one new member for the association during the coming year.

The president made some remarks in regard to living strictly up to M. C. B. Rules, as there seemed to be a tendency at some points to deviate from the rules due to local conditions and he felt there were no reasons why these rules could not be carried out at all points.

The following resolution was offered and call made for a rising vote, which was carried unanimously:

Resolved: That on our return home we take up with all concerned and make every effort possible to have the M. C. B. rules strictly enforced, it being felt by so doing at all points, if there is any reason why any of the rules cannot be carried out on account of local condition, they would be given a thorough trial, and we would be prepared at our next convention to make an intelligent report on this matter.

A great deal of discussion was had on the various rules in effect throughout the country where interchange bureaus were in operation; also, in regard to repairs made to foreign cars and bills rendered against the car owner for such repairs and it was the sense of the committee that such conditions should not exist and were inexcusable. The following resolution was offered and unanimously carried:

Resolved: In order that all interchange bureaus be operated uniformly, the M. C. B. rules of interchange, the A. R. A. rules and other operating rules be uniformly enforced, repairs to cars and bills for such repairs properly and uniformly made, that an inspection bureau be inaugurated along the lines of the United States Safety Appliance Inspection Bureau. This bureau to be under the jurisdiction of the arbitration committee of the M. C. B. Association and have authority to pass upon the rules to be put into effect, to see that they are uniformly enforced, and to receive complaints of irregular practices, and to have power to investigate and adjust complaints coming to their notice, and make such other investigations and inspections as they may see fit.

It was then regularly moved and seconded that the meeting adjourn.

NEW BOOKS

Drake's Telephone Handbook. By D. P. Moreton, Assoc. Prof. of Elect. Engr., Armour Institute of Technology. Cloth, 4½ in. by 6¾ in., 280 pages, illustrated. Published by Frederick J. Drake & Co., 1325 So. Michigan Ave., Chicago. Price, $1.00.

This book is intended primarily as a handbook to familiarize the practical telephone man with the intricacies of the telephone business to an extent which will enable him to intelligently apply the knowledge gained to the solution of problems which come up in his everyday work. In the space which the author has allowed himself he appears to have accomplished this result to a remarkable degree and to the man who will devote the necessary time to a careful study of the matter, the book should prove of considerable value.

The author is associate professor of electrical engineering in the Armour Institute of Technology, and it may be considered that he speaks with authority regarding the points which he discusses.

The book should have a definite field in that it covers the subject which it presents in a concise manner, and is of such a size that it may be readily carried around and made a volume of real ready reference.

It is well illustrated throughout in the matter of diagrams and circuits and illustrations of equipment.

A Locomotive With a Water Tube Firebox

An Experimental Locomotive Having a Firebox Equipped with Two Nests of Water Tubes Providing a Definite Water Circulation

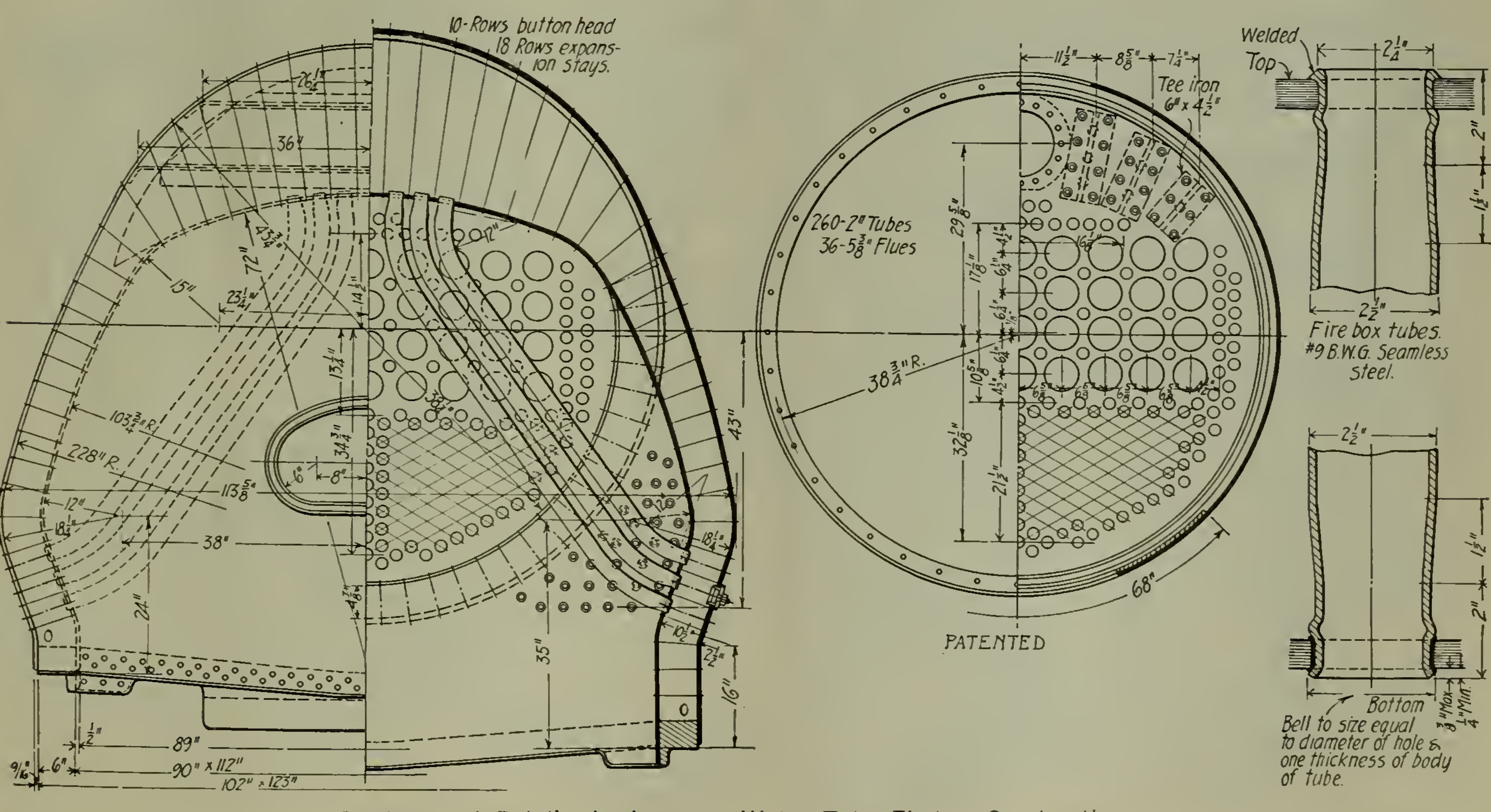
The Delaware, Lackawanna & Western received on December 17, 1914, an experimental engine No. 1171, one of a lot of fourteen built by the Lima Locomotive Corporation. This differs from its mates in that it received a boiler equipped with a special form firebox, patented by S. S. Riegel, mechanical engineer of the road.

By referring to the illustrations it will be noted the boiler consists of a combination of the standard type of firebox and shell, with a water tube construction, which introduces a definite water circulation system. This comprehends the installation of two nests of water tubes of sixty-six tubes each, placed right and left in the firebox over the grates, thus taking advantage of the water tube method of circulation, with the object of providing definite cycles of circulation of water through the zones of greatest heat intensity and locating the heating surfaces in the best possible manner.

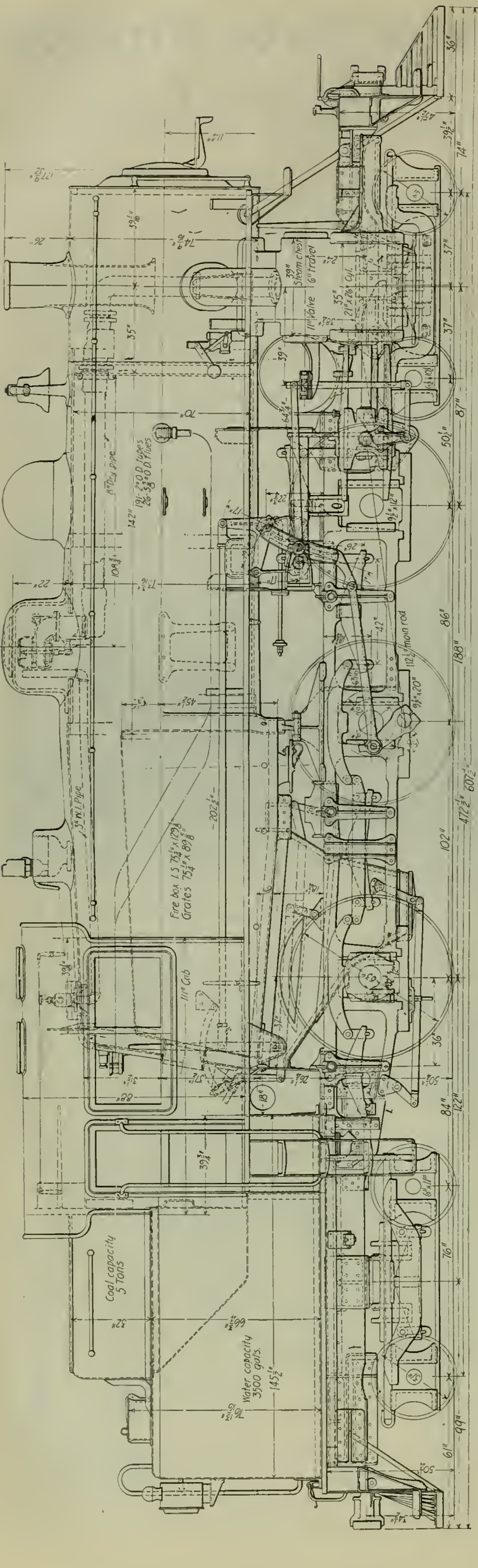
The total heating surface of the boiler is 494 sq. ft. greater than other locomotives of the same class, the experimental boiler having 3,960 sq. ft., while the other locomotives of this class have 3,466 sq. ft., not including the superheater heating surface. The heating surface of the firebox and combustion chamber of the experimental engine is 288 sq. ft., while that of the other engines is 267 sq. ft.

The engine has been performing very satisfactorily with both bituminous and anthracite coal through practically its entire period of service since delivery to the company, and it is believed that the device will prove an entire success. Arrangements are being made to give it

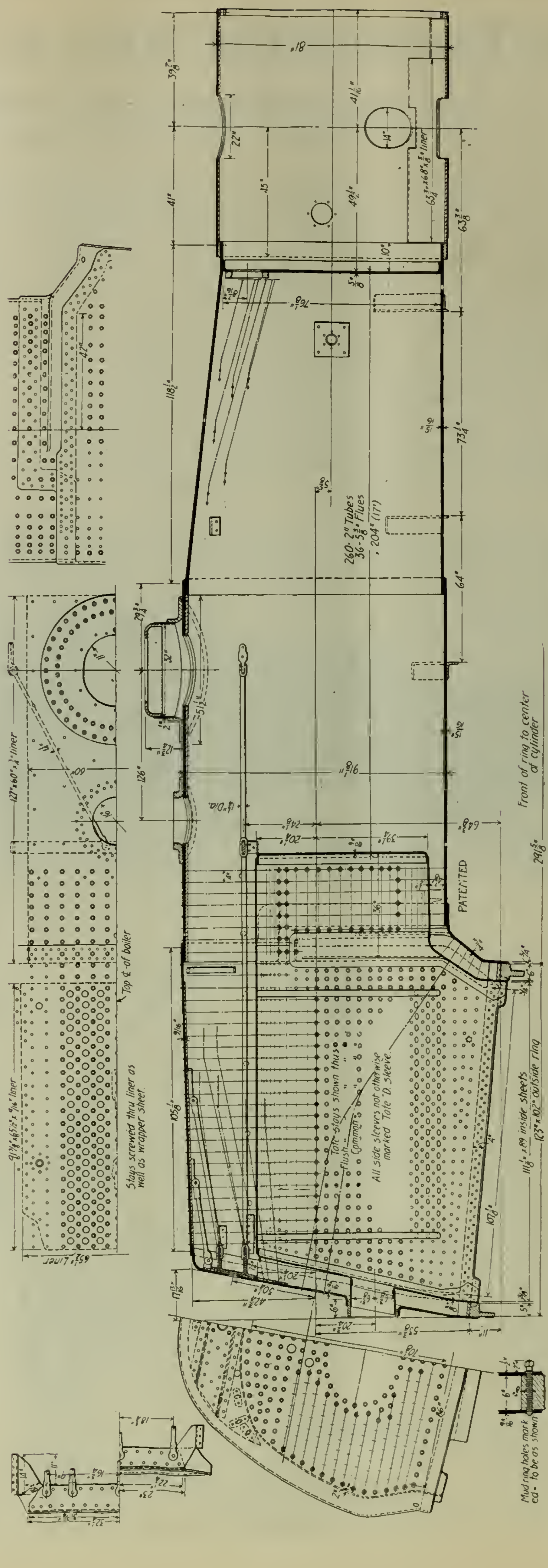
Lackawanna Locomotive Fitted with Special Boiler.



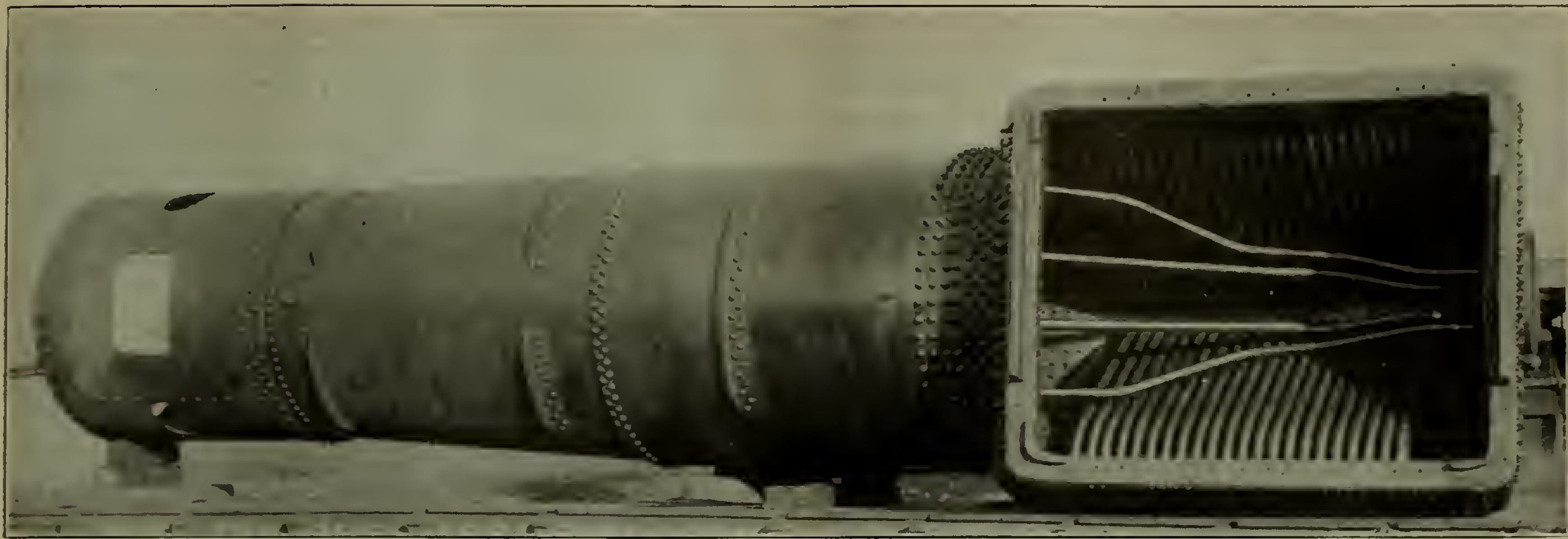
Sections and Details, Lackawanna Water Tube Firebox Construction.



Elevation of Lackawanna Locomotive Equipped with Water Tube Firebox.



Section of Special Lackawanna Boiler with Water Tube Firebox.



Showing Water Tube Construction of D., L. & W. Boiler.

a more thorough try-out in service performance in connection with the dynamometer car.

The sister engines, 1158 to 1170 class, were previously illustrated on page 479 of the October, 1914, issue of the *Railway Master Mechanic*.

The engine in question has the following special characteristics:

The engine in question has the following special characteristics:

Class	4-6-2
Gauge	4'-8½"
Diameter of driving wheels	69"
Tractive Power	43,200 lbs.
Cylinders	25x28"
Weight on trucks in working order	50,000 lbs.
Weight on drivers in working order	189,600 lbs.
Weight on trailer truck in working order	58,000 lbs.
Total weight of engine in working order	297,600 lbs.
Coal capacity of tender	10 tons
Water capacity of tender	9,000 gals.
Total weight of tender loaded	165,500 lbs.
Total weight of engine and tender	463,000 lbs.
Boiler pressure	200 lbs.
Grate area	69 sq. ft.
Diameter of boiler	78"
Firebox	89x111 sq. ft.
Factor of adhesion	4.39
Heating surface, firebox and combustion chamber	288 sq. ft.
Heating capacity, water tubes	471 sq. ft.
Heating capacity, fire tubes	3,177 sq. ft.
Heating capacity, arch tubes	24 sq. ft.
Total heating surface of firebox	783 sq. ft.
Total heating surface	3,960 sq. ft.
Superheater heating surface	740 sq. ft.
Rigid wheel base	13 ft.
Wheel base of engine	33'10"
Wheel base of engine and tender	66'4"

M. C. B. Inspectors for Checking Repairs to Foreign Cars

Suggesting a Force of Traveling M. C. B. Inspectors to Check Up Repair Cards, Records, and the Manner of Making Repairs

By H. H. Harvey, Genl. Car Fmn., C. B. & Q. Ry.

By way of introduction it might be well to call attention to the magnitude of foreign car repair work.

While I am unable to give exact figures, these quoted are, I think, approximately correct, as they are based on the actual bills paid by one of our large trunk lines and worked out by comparing the number of cars owned by that line with the total number of freight cars represented in the M. C. B. Association.

On that basis, there are during the course of a year nine million repair cards issued to cover repairs to foreign cars, and the money value represented by these cards is about forty-three million dollars.

Bills on authority of these repair cards are presented to car owners, who after checking for wrong car numbers, errors in arithmetic and apparent improper charges, vouchers them, with what, at best, is a very poor check as to whether he has gotten value received for the money.

In making the statement as to poor checking of M. C. B. bills, please do not misunderstand me and think I am saying bill clerks make no effort to get a good check, for such is not my intent. The facts are that it is simply impossible to check one of these bills and be absolutely certain that it does not contain charges for repairs that were never made.

In the very nature of things, it is not possible for the car owner to inspect each individual car to find what repairs it has received, and he has to depend almost entirely on the honesty of the roads over which cars travel as to whether or not improper charges are made for repairs.

There is probably no other part of railroad accounting where so much money is paid out on such a poor check, and it is also probably true that no other single matter in connection with the interchange of freight cars has been given more serious consideration by the Arbitration committee and other members of the M. C. B. Association.

As yet, nobody has been able to suggest a better scheme for M. C. B. billing, and so far as I know there is nothing better in sight. Such being the case, it follows that all car owners must be absolutely honest in their M. C. B. bill work, if we are to avoid the charge occasionally made as to dishonesty in repair bills.

For many years there has been more or less complaint about dishonest practices, and the M. C. B. Asssociation has made strenuous efforts to overcome such practices, if they actually exist.

To what extent they have succeeded, the writer is unable to say, but personally I believe that the great majority of roads are entirely honest and want to include in their bills only items that are legitimate charges against car owners.

Without question, all roads at times make improper

* A paper delivered before the Car Foremen's Association of Chicago.

charges, but in most cases these are simply errors and not made with deliberate intent to defraud. However, it is quite possible that some few car owners deliberately charge for repairs not made, possibly not with the consent of their higher officials, but through the zealousy of some of their minor officials, who are endeavoring to make a record for low cost of maintenance. These few, if there be such, are the ones who are to blame for the charge of dishonesty in repair bills, and under which stigma all must suffer, the innocent as well as the guilty.

As you know, it was for many years the practice to apply repair cards to cars, the idea being that this would enable owner to check repairs when car reached home. This was good in theory but poor in practice, as the dishonest party could easily get around it by omitting to apply repair cards. For this reason, and the further fact that repair cards applied to cars really served no very good purpose, the practice was discontinued a year or so ago.

In my opinion, the time is now ripe for some action to save car owners the financial loss due to improper bills, and to rid honest car men of the charge of crooked work.

The suggestion has been made that the M. C. B. Association employ a force of inspectors, whose sole duties would be to inspect foreign repairs and the billing in connection with them. The writer heartily endorses this suggestion, and would invite the serious consideration of the matter with a view of making some recommendations along these lines to the M. C. B. Association.

My idea would be to have a small force of inspectors, not to exceed five or six, at most, something like the Interstate Commerce inspectors, who would travel from point to point, check over repair cards, repair records, manner of making repairs, amount of material carried, etc., and to satisfy themselves that each road or private line is honest in all respects in their foreign repair work and billing.

These inspectors should be carefully selected, with a view of getting good, practical, level-headed men, who would distinguish between errors and actual dishonest practices. They should work directly under the supervision of the M. C. B. arbitration committee, and the expense prorated among car owners on the basis of cars represented in the association. Possibly it would be necessary to have them carried on the pay roll of the American Railway Association, but this detail could no doubt be worked out if it was decided to go into a scheme of this kind.

The benefits would be twofold:

First—In locating improper practices.

Second—The moral effect of such men being in the field would make everybody very careful to avoid anything that would cause criticism, in case inspectors should check them up.

The subject is one well worthy of serious consideration, and while this plan may not be the ideal one, I am sure the benefits obtained would more than offset the expense.

MAGNET FOR REMOVING METAL

The removal of pieces of shrapnel, steel-jacketed bullets, etc., by the use of powerful electro-magnets in hospitals abroad has been acclaimed by many newspapers as the very latest application of science to surgery. It is interesting to note that the Westinghouse Electric & Mfg. Co. has installed in the relief department of its East Pittsburgh works a magnet for removing metal embedded in the flesh, which is one of the most powerful in the world.

The magnet is mounted on a box containing the resistor which is used to regulate the amount of current flowing through the coils. It requires 4,000 watts for its operation, or enough power to supply 100 32-candle power Mazda lamps. It is designed for operation on 70 volts, and as the circuit from which it draws current is used for testing purposes in the works and ranges from 70 to 120 volts, a resistor is necessary.

Magnet for Removing Metallic Particles from the Hands, Eyes, etc.

It is not an infrequent occurrence for steel and iron workers to get bits of metal in their eyes or hands. Previous to the installation of a magnet the only means of removal was by probing, a method which is as uncertain as it is painful. Since this machine was put in operation it is a very simple proceeding to extract such particles. The portion of the body in which the foreign particle is embedded is placed near the pole tip of the magnet, switch closed, and magnet does the rest. The pole is removable, a number of different shapes being supplied for various classes of work.

It is very common for flying bits of metal to lodge in the eye. Should they strike with force enough to become embedded, the removal, without the aid of a powerful magnet, is apt to be difficult as well as painful. The protecting coating of the eye must be cut, and there is danger that instead of removing the particle, it may be pushed further into the eye. When the foreign body is once within the eyeball it is properly a case for the specialist.

Steel workers frequently have their hands punctured with minute pieces of metal, which become embedded under the calloused skin. If these bits are allowed to remain, the wound is likely to become infected. The use of a powerful magnet insures the removal of all traces of iron from wounds in the hands or any other part of the body. Some remarkably small pieces have been extracted in this way, one recently recovered being not a twelfth of the thickness of a delicate needle.

Dr. C. A. Lauffer, medical director of the Westinghouse Electric & Mfg. Co., relates a number of instances in which the magnet has proved invaluable. Among these is the rather amusing case of a workman who attempted to drill one of his own teeth. The drill broke off about half an inch from the end and remained in the cavity, and it seemed as if the only way to remove the drill would be to pull the tooth. However, a special extension was made and fitted to the magnet pole. As soon as the extension was brought in contact with the drill and the current switched on, the drill was immediately drawn out.

The Car Surplus

The American Railway Association reports the total car surplus on February 15 at 227,473, which compares with 211,960 on the same date last year, and 172,325 Nov. 1, 1914. The reports of February 15 have been received from 159 roads, operating 1,854,150 cars, while figures for Nov. 1, 1914, were furnished by 192 roads, operating 2,203,414 cars. The total shortage Feb. 1, 1915, was 832, which compares with 2,282 a year ago, and 2,229 Nov. 1, 1914.

PERSONALS

W. H. Kushera succeeds L. Showell as general foreman of the *Atchison, Topeka & Santa Fe* at Deming, N. M.

T. G. Evans succeeds J. H. Suhl as foreman of the *Atchison, Topeka & Santa Fe* at Las Vegas, N. M.

A. M. Baird, assistant superintendent of shops of the *Atchison, Topeka & Santa Fe* at Topeka, Kan., has resigned to engage in other business.

J. D. Osborn succeeds Thomas Purcell as boiler foreman of the *Atchison, Topeka & Santa Fe* at Richmond, Cal.

C. M. Newman has been appointed superintendent of shops of the *Baltimore & Ohio Southwestern* at Washington, Ind.

C. A. Loudin succeeds J. W. Eubank as road foreman of engines of the *Chesapeake & Ohio* at Huntington, W. Va.

V. J. Lamb has been promoted to general car foreman of the *Charlestown & Western Carolina* at Augusta, Ga., succeeding W. F. Weigman.

Otto J. Protz has been appointed shop foreman of the *Chicago & Northwestern* at Wyeville, Wis.

E. H. Morey has been appointed foreman of the new erecting and machine shop of the *Chicago & North Western* at Chicago.

E. Bloom has been appointed shop demonstrator and chief apprentice instructor at the Chicago shops of the *Chicago & North Western*, succeeding E. H. Morey.

R. W. Stevens succeeds the late J. M. Warner as general superintendent of *Chicago & Western Indiana*, with headquarters at Chicago. He will have charge of operating maintenance and mechanical matters.

A. Young succeeds Walter Alexander as master mechanic of the *Chicago, Milwaukee & St. Paul* at Milwaukee, Wis.

C. Lunberg succeeds A. Young as general locomotive foreman of the *Chicago, Milwaukee & St. Paul* at Chicago, Ill.

R. J. McQuade has been appointed master mechanic of the Kansas City terminal division of the *Chicago Rock Island & Pacific* vice O. C. Breisch, resigned. His headquarters are at Armourdale, Kan.

A. E. Caskey has been appointed road foreman of equipment of the *Chicago, Rock Island & Pacific* at Valley Junction, Ia.

E. B. Van Akin has been appointed road foreman of equipment of the *Chicago, Rock Island & Pacific* at Manly, Ia.

J. W. Sullivan succeeds W. R. Elmore as general foreman of the *Denver & Rio Grande*, with office at Salt Lake City, Utah.

O. N. Ballard succeeds F. Kinze as general foreman of the *Detroit, Toledo & Ironton*, with office at Delray, Mich.

J. H. Conley has been appointed purchasing agent of the *Georgia & Florida*, with office at Augusta, Ga.

W. R. Wood has been appointed mechanical valuation engineer of the *Great Northern*, with headquarters at St. Paul. He will report to the general manager.

A. M. Phelan has been appointed locomotive foreman of the *Great Northern* at New Rockford, N. D. He succeeds J. J. Stahl.

E. G. Bryant succeeds W. G. Hall as master mechanic of the *International & Great Northern* at Mart, Tex.

H. L. McLow, general foreman of the *Missouri, Kansas & Texas* at Greenville, Texas, has resigned to become superintendent of the Greenville municipal plants.

J. A. Long has been appointed acting general foreman of the *Missouri, Kansas & Texas* at Greenville, Texas, succeeding H. L. McLow.

M. S. Ransom has been appointed general foreman of the *Nashville, Chattanooga & St. Louis*, with office at Atlanta, Ga.

J. W. Hager has been appointed locomotive and fuel inspector of the *Nashville, Chattanooga & St. Louis*, with headquarters at Nashville, Tenn.

A. R. Ayers has been appointed principal assistant engineer of the equipment department of the *New York Central*, with headquarters at New York. His general duties will be in connection with car design and construction.

R. M. Brown has been appointed assistant engineer of the equipment department of the *New York Central*, with headquarters at Cleveland, O. His duties will cover engineering and drafting at locomotive and car shops.

P. P. Mirtz has been appointed assistant engineer of the equipment department of the *New York Central*, with headquarters at New York. His duties will cover locomotive design and specifications.

H. E. Smith has been appointed chemist and engineer of tests of the *New York Central*, with headquarters at Collinwood, O. He will have supervision of laboratories and material inspection.

W. B. Geiser has been appointed assistant chemist and engineer of tests of the *New York Central*, with headquarters at West Albany, N. Y.

Joseph Chidley, assistant superintendent of motive power of the *New York Central* at Cleveland, O., has had his jurisdiction extended over the Illinois division.

George Thomson, master car builder of the *New York Central* at Englewood (Chicago), Ill., has had his jurisdiction extended over the Illinois division.

A. Berg has been appointed general foreman, car department, of the *New York Central* at Wesleyville, Pa., vice O. Blodd.

R. A. Fitz, general foreman of the *New York Central*, has been transferred from Sandusky, O., to Nottingham, O.

W. H. Kropp has been appointed roundhouse foreman of the *Oregon-Washington R. R. & Navigation Co.* at Seattle, Wash., succeeding O. K. Rummell.

F. B. Farrington has been appointed general foreman of the *Pennsylvania* at Louisville, Ky., succeeding C. W. Kinnear.

Leeds C. White succeeds A. White as general car foreman of the *Pere Marquette* at St. Thomas, Ont.

W. F. Weigman has been appointed general foreman car department of the *Seaboard Air Line* at Portsmouth, Va.

J. M. Guild has been appointed general safety agent of the *Union Pacific* at Omaha, Neb. Mr. Guild was formerly assistant general safety agent.

J. R. Van Cleve has been appointed master mechanic of the *Western Pacific* at Elko, Nev., succeeding E. R. Kries.

OBITUARY

John W. Addis, formerly superintendent of motive power of the *Texas & Pacific*, died at Marshall, Texas, on February 25. Mr. Addis retired in June, 1911, after serving 19 years as head of the mechanical department of the Texas & Pacific.

Samuel C. Howe, division accountant of the *New York Central*, died suddenly at his home, 12 Colby street, Albany, New York, February 2nd, at the age of 46 years. Mr. Howe was born in Huddersfield, England, and came to this country when he was 23 years old. He obtained employment in the New York Central shop at East Buffalo and afterward changed to the office and entered the accounting department. There he gained many advances and in 1904 was given charge of the accounting department in the western division. In 1910 he was advanced to the Hudson and Mohawk divisions, and moved to Albany with his family the same year. He is survived by his wife, son and two daughters. Mr. Howe had been for many years a member of

the Chief Interchange Car Inspector's and Car Foremen's Association, and while not directly connected with car interchange work, he was so closely associated with men having charge of this work that he took a deep interest in all of the association's work and was a regular attendant at the meetings. He took an active part in the discussions and his sudden taking off will be felt very keenly by the membership in general. Mrs. Howe always attended the conventions with her husband and the sympathy of the membership is extended to Mrs. Howe and her family.

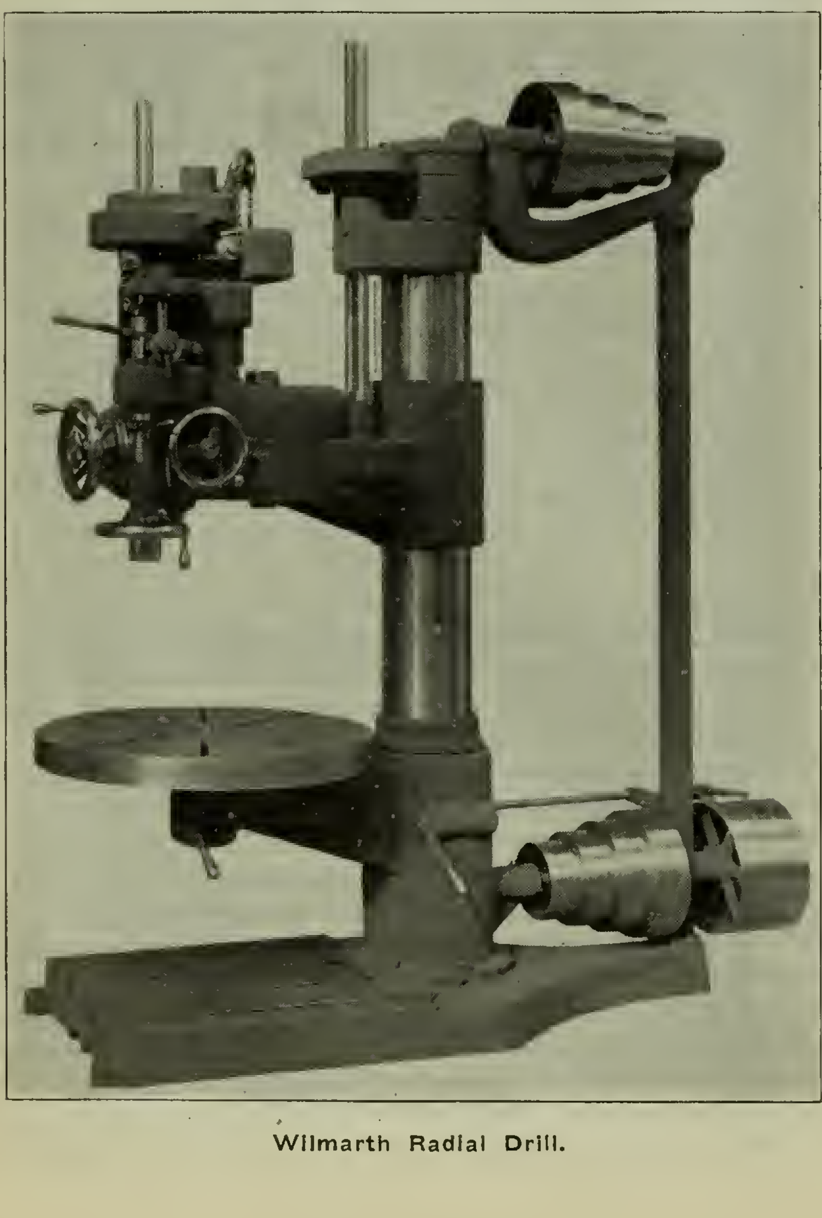
WILLMARTH RADIAL DRILL.

A radial drill which is distinctly new in principle and design has been placed on the market by the Willmarth Tool Works, 1510 E. 32nd St., Cleveland, O.

Its most prominent feature is the manner of moving the head and arm for locating holes. The head rotates about a large circular bearing on the arm, and the arm rotates about the column as in the usual type. This produces a double swiveling motion, so that any hole within the capacity of the machine may be readily located. (A self-locking spiral gear and rack are provided for moving the head.)

The bearing of the head on the arm is 17" in diameter, and is provided with an annular ring inside for holding it central, and a heavy pivot bolt for holding the two together. A powerful eccentric clamp locks the head solidly to the arm, making substantially one piece.

The column is of the post and sleeve type. The post has a large and heavy lower portion, and extends up to the top member, which is securely bolted to it, making a braced construction and adding materially to the stiffness. The column sleeve telescopes the post, and has bearings at both top and bottom, also a large ball thrust bearing at the bottom end, thereby rendering easy the swinging of the arm. The sleeve has a powerful binding clamp at its lower end, which when tightened, produces the effect of a solid column.



Wilmarth Radial Drill.

The arm is very rigid, of cylindrical box section, and heavily ribbed on the inside. It is elevated or lowered by means of gearing at the top through a coarse pitch screw, hung on ball bearings.

There are eight changes of speed, from 35 to 375 R. P. M., arranged in geometrical progression. Four changes are obtained by the cone pulleys and four more by the back gearing, which is provided in the spindle driving gears.

The tapping mechanism is obtained by a jack shaft in the head, running at high speed, and drives through powerful ring clutches, which are self adjusting, and which are operating by means of a lever in front of the machine, enabling the workman to easily start, stop or reverse the spindle.

The spindle is of special steel, is accurately ground and is provided with an ample ball thrust bearing. It has a No. 5 Morse taper hole, is 3¼" in diameter at its large end and 1⅜" at its smallest section.

The feeding mechanism is composed of a selective gear box and its gearing, which drives a worm and worm gear, which in turn drives the feeding pinion. Six changes of feed are provided, ranging from .006" to .027" per revolution of the spindle. These are instantly available by operating the dial on the front of the feed box. A quick return hand wheel is attached to the feed pinion shaft, and the engagement of the worm to it is made by means of a friction ring controlled by a nut in front of the hand wheel. Both depth gauge and automatic trip are incorporated in the feed mechanism.

The bearings throughout are bushed with high grade special bearing bronze, and the gears are of steel, bronze or a specially high grade semi-steel.

AUTOMATIC NUT TAPPER

A great deal of energy and inventive genius have been expended on the bent or curved tap principle in an effort to develop a continuous, non-reversing nut tapper. The quest or effort to utilize the bent tap has gone on uninterruptedly, as the partial successes attained in previous designs indicated that the bent tap held much promise, and that in theory at least, it offered the way for a full automatic nut tapper without any reversing action to wear out taps and cause trouble, and in which various movements were attainable without the employment of intricate or delicate mechanism.

These possibilities have been realized in a new automatic nut tapper now being offered by the National Machinery Company, Tiffin, Ohio, and on lines simpler than those embodied in the theories of the early experimenters. This tapper is being built in sizes of ¼, ⅜, ½ and ¾ inch capacity The hopper or container for the blanks, while apparently on accepted lines, embodies some original ideas and is made unusually large. On the smaller size machines it accommodates about 80 lbs. of blanks, thus giving the operator considerable time between fillings and enabling him to easily attend a battery of from 6 to 10 machines.

A vane type feed progresses the nuts from the hopper to the feed chute, and gravity brings the blanks down and into position against the plunger or starter. There are four of these feed vanes, and they are so enclosed that the pressure or weight of the blanks cannot interfere with their successful operation. These vanes are rotated by a ratchet and pawl off the driving shaft, and this ratchet is held between friction flanges so that in case scrap or thin nut blanks tend to wedge in the nut groove and

interfere with the vanes, the ratchet merely slips, and damage is prevented.

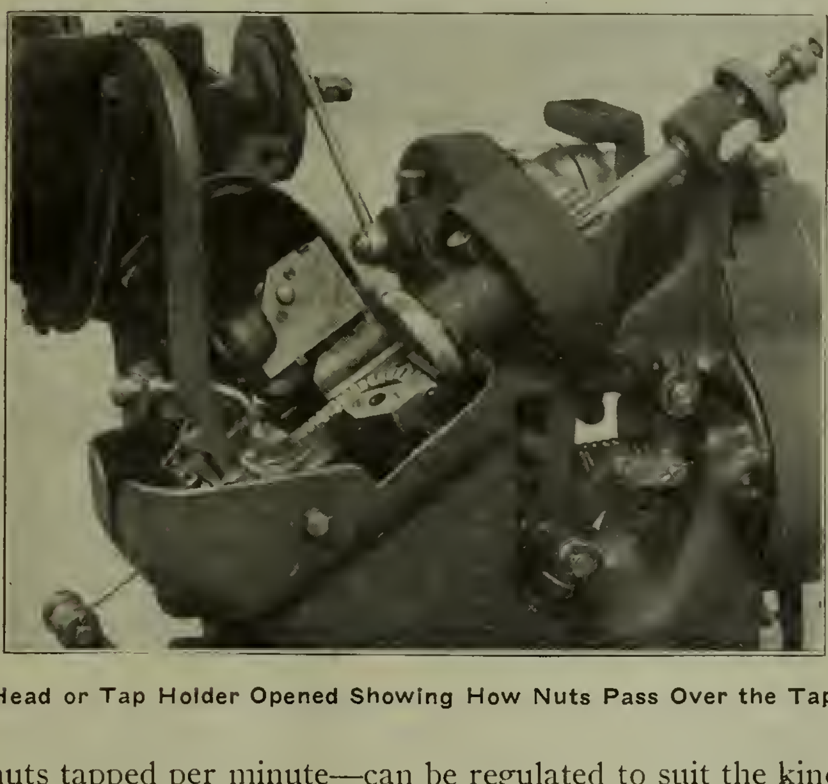
The tap spindle and injector or starter is inclined at an angle, and the blanks come out of the feed chute at a like angle, causing each blank to lay against the starter as it is advanced onto the tap. The angle of the starter is such that the lubricant keeps the face free of chips, and the blanks lay or bear flush against the starter, and are thus tapped square with the bearing face.

The tap spindle has a slight lateral travel, and is counterbalanced, giving the spindle a "floating" movement in a sense, and after the starter has fed the blank part way onto the tap, the spindle descends during the completion of the tapping, thus keeping the blank stationary while it is being tapped, in place of pulling it through the nut holder or guides and incurring a chance of binding, with attendant excessive wear on the nut guides and tap.

The course of the nut after being tapped, i. e., its travel up the shank and off the end of the tap, is made clear in illustration No. 4. The hood or cover over the head serves to direct the nuts ejected from the tap into a chute that conveys them out of the machine into boxes or kegs.

It follows, of course, that the better the quality of blank being tapped, i. e., freedom from burr, holes of correct size, stock free cutting and blanks of correct dimensions —the higher the machine's efficiency, and all blanks before being dumped into the hoppers are sorted for scrap-slugs. etc., but should any scrap accidentally enter and be passed through the feed chute and fed against the tap, an automatic relief shifts the belt and stops the machine.

The design is intended primarily for tapping square nuts, but hexagon nuts of good quality can be handled; and each size tapper can be tooled for handling both styles of nuts, as well as for several sizes. Also by making a simple gear change, the rate of feeding—number of



Head or Tap Holder Opened Showing How Nuts Pass Over the Tap.

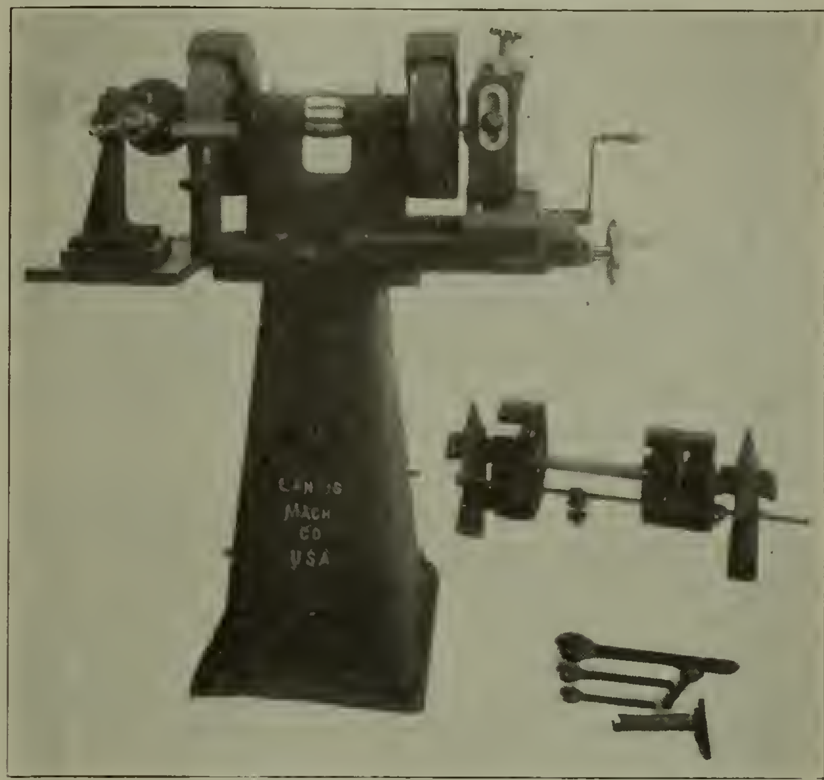
nuts tapped per minute—can be regulated to suit the kind of nuts being tapped. As an example, in the 3/8 inch size machine, 40 nuts of shop size can be tapped per minute if the stock is free cutting, holes are full size, etc., whereas U. S. S. nuts being thicker require more turns of the tap to a nut, hence 30 nuts per minute are recommended. This also applies when nuts are of tough stock or the holes run smaller than standard.

No special type or grade of tap is necessary, and any standard tap that has been successfully employed in a shop in the straight shank will be found equally satisfactory in the bent form for this automatic tapper.

LANDIS CHASER GRINDER

The chaser grinder illustrated herewith has recently been perfected by the Landis Machine Company, Waynesboro, Pa., to meet the demands and requirements of the many users of thread cutting dies and more especially the Landis die.

The machine is of a duplex nature, in that it is fitted with an attachment for handling all sizes of Landis chasers and a device to sharpen the disc cutters of roller



Landis Chaser Grinder.

pipe cutting machines. It may also be used to grind lathe, planer, shaper tools, etc.

The chaser grinder attachment has adjustment in both horizontal and vertical planes, with suitable graduations for controlling the lead and rake angles, on Landis dies. Both the transverse and longitudinal feeds are in horizontal planes, a feature which insures very accurate grinding. The table is gibbed at both slides and finished with an overhang to protect the guides from emery dust.

The disc cutter grinding attachment is also adjustable vertically and horizontally and is operated by hand. An adjustable rest is likewise provided to facilitate the handling of miscellaneous tools.

The rigid construction, guarded wheels and the ease with which the machine may be operated are features which should not be overlooked and which, together with the universal adaptability of the machine, should make it a most desirable equipment for the tool room.

NEW LITERATURE

The Globe Ventilator Co., Troy, N. Y., has issued a booklet calling attention to the particular uses of Globe ventilators in railway work.

* * *

"Type E Stoker" is the title of a catalog of the Combustion Engineering Co., 11 Broadway, New York. This stoker is of the underfeed type, burning coking or noncoking coal ranging from 10 to 40 per cent volatile matter and 5 to 30 per cent ash, under stationary boilers.

* * *

The Blaisdell Machinery Co., Bradford, Pa., is sending out copies of a well arranged catalog of its smaller air compressing machines. The booklet is more than a mere catalog, as it contains many tables and other valuable information.

THE SELLING SIDE

The Safety First Federation of America, which recently held its first convention in New York City attended by delegates from 14 states, selected Detroit as the next place of meeting next autumn. The federation is designed to promote the public safety movement and to co-ordinate the work of many public safety bodies.

The Elyria Iron & Steel Co., Elyria, O., has placed the structural steel contract for its proposed tube mill to be built at Cleveland with the Fort Pitt Bridge Works, of Pittsburgh. About 215 tons of steel are involved.

The Bader-Giebel Machine Co. has been incorporated at Cincinnati with $15,000 capital stock. The incorporators are William C. Bader, George J. Giebel, Mildred Bader, Mamie Giebel, Dennis J. Ryan.

The Stark Rolling Mill Co., of Canton, Ohio, announce the appointment of The Dearborn Steel & Iron Co, as their selling agents in Chicago, northern Illinois and Wisconsin. The Dearborn Steel & Iron Co. is a new company, composed of H. C. Perrine and E. L. Lyon. Both were formerly connected with Jos. T. Ryerson & Son, and Mr. Perrine more recently was associated with The Fred Gardner Co. Offices have been opened in the Peoples Gas building, Chicago.

The Stowell Mfg. & Foundry Co., South Milwaukee, Wis., reopened its foundry, machine and shipping departments on March 5 after being closed since December 1.

The General Railway Signal Co. reports for the year ended December 31, 1914, earnings of $526,167, balance after interest, $54,570; surplus, $1,842, and profit and loss surplus of $1,215,831.

L. S. Starrett Co., manufacturer of machinists' tools, will increase its capital stock $1,500,000.

The Brooks plant of the American Locomotive Co. at Dunkirk, N. Y., is showing more signs of active resumption in part by the employment of hammersmiths and blacksmiths on some recently booked orders.

The Lackawanna Steel Co., at its annual meeting, elected directors for the term of three years, expiring March, 1918, as follows: J. J. Albright, C. Ledyard Blair, Warren Delano, J. G. McCullough, Moses Taylor and Henry Walters. James Speyer having declined re-election, was succeeded by Beekman Winthrop, of New York City.

The old plant of the American Asphalt & Rubber Co., at Lawrenceville, Ind., will be reopened by a reorganization of the American company, known as the Canadian Mineral Rubber Co. The plant will be rebuilt and re-equipped and a new office building probably will be erected. W. B. Puller, former chief chemist of the American company, is general manager of the new concern.

Directors of the Union Switch & Signal Co., Pittsburgh, organized with the election of the following officers: President, W. D. Uptegraff; vice-president, T. W. Siemon; vice-president and treasurer, T. S. Brubbs; secretary and assistant treasurer, George F. White.

Harry G. Uphouse, formerly Johnstown sales manager of the Cambria Steel Co., has succeeded to the title of assistant to the general manager of sales, a position held until March 1 by Merrill G. Baker. Mr. Uphouse has been with the Cambria company for a number of years, obtaining his initial experience in the operating department. Mr. Uphouse will be connected with the Philadelphia office of the company.

J. W. Fogg, formerly master mechanic of the Baltimore & Ohio Chicago Terminal, has become associated with the Boss Nut Co., Chicago.

T. S. Leake, general contractor, has moved his offices from the Ellsworth building, Chicago, to the Transportation building.

James Hartness, former president of the American Society of Mechanical Engineers and president of the Jones & Lamson Machine Co., Springfield, Vt., delivered a lecture on March 9 before the Engineering Society of Stevens Institute of Technology, Hoboken, N. J. His address was devoted to "Modern Practice in Tool Design."

E. L. Leeds, since 1907 the manager of the railroad equipment department of the Niles-Bement-Pond Co., 111 Broadway, New York, has been appointed general manager of sales of that company and of the Pratt & Whitney Co., Hartford, Conn. Mr. Leeds succeeds W. L. Clark, formerly vice-president in charge of sales of Niles-Bement-Pond, and B. M. W. Hansen, vice-president of the Pratt & Whitney Co., who previously had been in charge of the Pratt & Whitney sales. The change became effective March 1.

Wellington B. Lee, formerly with the Ramapo Iron Works, Ramapo, N. Y., has been elected vice-president of the Track Specialties Co., Inc., New York City. Mr. Lee severs his connection of 24 years with the Ramapo Iron Works.

George T. Merwin has been appointed general sales manager of the Canadian Car & Foundry Company, Montreal, Que.

The Chicago Pneumatic Tool Co., Chicago, re-elected the old officers and directors at the annual meeting held recently.

George G. Barret, formerly general manager of the Cleveland Drop Forge Company, and at one time connected with the American Locomotive Company, died at his home in Commack, L. I., on February 18.

The Chicago Bridge & Iron Works has opened a city sales office in the McCormick building, Chicago.

The Empire Railway Appliance Co., 30 Church street, New York, has increased its capital stock from $500,000 to $600,000.

Thomas A. Edison, Inc., will erect a benzol recovery plant, at Johnstown, Pa., as a result of negotiations closed with Cambria Steel Co.

Manning, Maxwell & Moore, Inc., New York City, are making preparations to operate their new plant in Fitchburg, Mass. H. F. Brandeis, general manager of the Fitchburg plant, speaks cheerfully of the outlook in the machine tool trade.

A. D. McAdam, western sales agent of the Ralston Steel Car Co., Columbus, O., has been named manager of sales of that company with headquarters at Columbus.

The Fairmont Machine Co. has changed its name and increased the authorized capital stock to $1,000,000 to meet demands of increasing business. The name will hereafter be the Fairmont Gas Engine & Railway Motor Car Co.

The General Brake Shoe & Foundry Co., Chicago, will open a branch in Memphis, Tenn., under the name of the Memphis Brake Shoe & Foundry Co., says a Memphis dispatch.

The Magnus Company, Chicago, has been incorporated with a capital stock of $5,000 to manufacture railway supplies of iron and steel, by W. H. Clark, 140 South Dearborn street, P. R. Weingardner and W. F. Kennedy.

The Pyle National Electric Headlight Co., of Chicago, has acquired the patents and business of the W. T. Van Dorn Co. for the manufacture of steel ends for box cars. The Van Dorn patents include single piece and sectional ends; and among them are some covering recent improvements.

The Railway Appliances Co. has been sold to C. F. Quincy, president of the Q. & C. Company. The business of the Railway Appliances Co. will in future be operated by and in the name of Q. & C. Company.

The Alma Standard Foundry Mfg. Co., Alma, Mich., will increase the size of its plant as the result of contract with the Ann Arbor railroad to furnish all castings for the railroad for 1915.

OBITUARY

Jed O. Gould, general superintendent of the Gould Coupler Company, at Depew, N. Y., died on February 19, at Buffalo, N. Y.

William F. Gurley, of the firm of W. & L. E. Gurley, Troy, N. Y., died at Atlantic City on Wednesday, February 17.

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Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF THE RAILWAY MASTER MECHANIC, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24, 1912.

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Known bondholders, mortgages, and other security holders, holding 1 per cent or more of total amount of stock—None.

(Signed)
BRUCE V. CRANDALL, PUBLISHER.

Sworn to and subscribed before me this 31st day of March, 1915.
(Signed) Robert R. Grieg,
(My commission expires Oct. 26, 1915.) Notary Public.

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CONTENTS.

The Old-Time Finish

During recent years there has been a tendency towards extreme simplicity in design and finish of locomotives and cars. In the earlier days of railroading, however, rolling stock was finished with quite elaborate striping and more or less brass, and some of the earlier locomotives had an individuality which made their drivers very proud of them. Reference to an article covering some of these old-time locomotives which is published on another page indicates their handsome appearance and illustrates how a little striping or gold leaf can improve an engine's appearance.

In our zeal over efficiency we sometimes lose sight of the human factor and there are indications that the pendulum is swinging back again toward the old-time finish. A number of roads, for instance, are giving individuality to some of their locomotives by placing thereon the names of their drivers. There are those of the opinion possibly that the addition of striping and gold leaf is costly and unwarranted, but it should be borne in mind that the cost is practically insignificant compared with the total and that the effect in making the men proud of their road's engines will offset the cost several times.

More of the old-time finish could also be advantageously applied to the passenger cars of today, especially with the increase in steel construction. The steel car at best is very plain and uninviting. More gold lettering and other touches of brightness would greatly relieve its monotonous appearance, and the road providing the more attractive cars will attract additional passengers. The public undoubtedly appreciates the strength and safety of the steel car, but at the same time the average passenger wants to travel in an attractive looking conveyance.

The cost of brightening up the appearance of our rolling stock is comparatively insignificant. It will give a road an individuality, will create a spirit of pride and loyalty among employes and will attract passengers. There is a tendency towards more of the old-time finish.

Successful Smoke Washing

The problem of doing away with the smoke from a roundhouse is one of increasing importance in large cities, especially if the house is located near or in a residential section. In the past some attempts have been made, with more or less indifferent results, to wash the smoke in cases of this sort and at present a number of installations of this character are being tried out. The Pennsylvania, for instance, has been working on smoke elimination at its Allegheny engine house for some time.

One of the most interesting installations along this line is that at the Englewood roundhouse, at Sixty-third street, Chicago, on what is now known as the New York Central. This installation, which has been previously described, has now been in operation for over a year and is proving very satisfactory. When first installed, considerable difficulty was experienced by corrosion of metal parts, especially those which came in contact with moisture. These have been replaced with wood, which works

very satisfactorily. Even the stack for carrying away the steam has been made of wood. The smoke is forced through six or eight inches of water held in a concrete tank and the corrosive action was found to be such that even the concrete commenced to disintegrate. Accordingly the tank was lined with wood, which it appears is well adapted for this work.

The black soap-like scum is skimmed off the water twice a day, and is dried to a powder in a box containing steam coils. It is then placed in paper sacks and the mechanical department now expects to find a market for it as lamp-black. The astonishing feature is that five barrels of this dried and powdered smoke are collected every day, the roundhouse being only a little over a half-circle.

Now when it is considered what five barrels of this black powder would do to a neighborhood if scattered around every day of the year, it must be conceded that this smoke washing plant is a success. A man who lived in the vicinity came to the roundhouse a short time ago and asked the foreman what they were doing, saying that things had been exceptionally clean around his home in the past year and he had not seen any smoke. The foreman then showed him the smoke washing apparatus and the work it did, whereupon the visitor said, "Well, I never would have believed it; I'll never say anything against the Lake Shore as long as I live."

There are, of course, comparatively few localities where a smoke washing plant is needed or required, but where this is the case it is usually badly needed. It has been demonstrated that such work can be done successfully and it now appears that even smoke can be converted into money. And when the people who live nearby begin to feel as did the visitor to the Englewood roundhouse, the railway in question has gained friends, which is something every road can afford to cultivate.

Car Men's Associations

There has been a marked increase of interest on the part of car foremen, inspectors and repair men, in getting together and discussing topics of mutual interest of late. Two or three car men's associations have been formed at leading centers and others are contemplated. One of our readers suggested in last month's issue that such associations be formed in all cities where interchange of cars take place and that these in turn be members of a general association, mentioning among the advantages that such a plan would eliminate a large number of recommendations as to changes in rules which now come to the Master Car Builders' Association from many individual organizations.

In general this suggestion contains considerable merit. In the past, car men in different sections of the country have placed varying interpretations on some sections of the rules and this plan would serve to bring them even closer together than they are at present. The car foremen, inspectors and repairmen are actually on the job every day and therefore they are in a position to make valuable suggestions which when boiled down through the medium of a general association should prove a great help to the Master Car Builders' Association. Furthermore, the spirit of co-operation induced by the monthly meeting of the local association tends to cause all to work together in greater harmony.

The working out of the suggestion referred to would not be a difficult task, as the general groundwork is ready for it. There is already a general association which would exactly fit into the plan, namely, the Chief Interchange Car Foremen's and Car Inspectors' Association. This association has been doing admirable work and its recommendations to the Master Car Builders' Association have in many cases been adopted. The formation of local branch clubs would still further strengthen this organization.

There are already strong local associations at Chicago, St. Louis, Buffalo, Cincinnati, Toledo and possibly at other points. Nearly all members of these associations belong to the national association and the working out of the suggested plan would simply mean bringing all these into closer harmony and getting a working basis for making recommendations for changes in the rules.

This plan would strengthen all the bodies involved and would greatly simplify the work of the arbitration committee by eliminating a large number of recommendations, many of which are often nearly identical. Last but not least it would bring all the car men of the country into closer working harmony, which could only result in a better and fairer interpretation of the rules.

Advantages of Good Lockers

Practically all shops of modern construction are equipped with sanitary lockers and improved toilet facilities for the workmen, as it is recognized that they are essentials of good organization. The employee who is made to feel that his surroundings are being made more healthy and agreeable is going to go about his work cheerfully, and as a consequence will be a better workman.

Good clean steel or wood lockers tend to make employees take better care of their shop clothing and of themselves. In a shop where no locker provisions are made, often old grease-soaked overalls will be stored away under benches or in drawers, thus increasing the fire hazard, in addition to the general effect on the men. Very frequently, also, shop tools will be found in the pockets of these discarded garments or wrapped up in them. In a shop with no locker system, each workman gets a box, a cupboard or a drawer for keeping his things, and these places usually contain a varied assortment of junk. With a locker system, these things can be done away with and the building given a general housecleaning. Furthermore, considerable time will be saved during working hours, for with individual lockers set apart from the shop, there will not be the tendency for workmen to find occasion to visit them. No lockers means dirty and torn shop garments, which undoubtedly increase the chances for injury.

REORGANIZE THE COMMISSION

Daniel Willard, president of the Baltimore & Ohio. made the following suggestion in a recent address before the students of Dartmouth College:

"The Interstate Commerce Commission should be enlarged and reorganized and its powers so broadened that it may be able to deal promptly and effectively with the various matters under its jurisdiction. It is not able to do so at the present time. The Interstate Commerce law as it is today reflects the influence in the past of a nation-wide demand upon Congress to enact a law or laws which should primarily be sufficient to protect the public from the assumed greed of the railroads, and to that end the commission has been given the power among other things to order rate reductions and to prevent rate advances. It is right that the people should be protected from the selfishness of the railroads, but it is equally important that the railroads be protected from the unreasoning demands of the public. The commission should be given the power to fix the minimum as well as the maximum rate which the railroads may charge. It should be kept in mind that the demands of the growing commerce in this country make necessary an annual expenditure by the railroads for additions and betterments of not less than $750,000,000. If those having money to invest lose confidence in the stability of railroad securities, that fact is immediately reflected in reduced railroad expenditures for additions, betterments and equipment. Such expenditures at the present time I believe are at the lowest point reached in the last fifteen years, and much below the amount necessary to maintain the existing standards of facilities and service, and while the European war has had some effect, the situation was very serious before the war broke out and reflected in no small degree the results of our general policy of railroad regulation, particularly during the last ten years."

LETTERS TO THE EDITOR

Editor, *Railway Master Mechanic:*

The writer has been in railway service on one of the large trunk lines of this country for the past nine years in the mechanical and transportation departments, performing the work of a sub-official in both departments in capacity of chief clerk. After careful study and deliberation of the situation it is my opinion that the lack of co-operation on the part of the railway employees can be directly chargeable to the railways themselves for not making the employee a co-partner in the business.

Quite recently the largest telephone company in this country published the fact that its stock would be sold to its own employees, allowing them to pay for same in monthly installments from their earnings, charging interest on the unpaid balance and at the same time paying the employee a dividend on the amount of stock held by him. Does it not stand to reason that such an employee would feel that he was a personal unit in this company's business and would he not put forth greater effort to further the interest of his company, knowing at the same time that he is building up his own business? Most assuredly.

Then why would the same plan not work with the railways? Instead of selling their stock to outside and foreign capital, sell it to the employee, make him a partner in the business, thereby cementing the organization together as one unit.

It is nothing more than natural that any man will work to his own interests at all times. With the train dispatcher a stockholder he will use every effort to avoid holding his trains on sidings for hours in order to accomplish a "meet" that could have been executed further down the line; the trackman will not put off until tomorrow the small job on that piece of track to bring it up to the required standard; the shop man will not take the chance of causing an engine failure by throwing his work together hurriedly; the car repairer will not pass by that missing box bolt nut, thereby laying the car liable to derailment and resultant delay. Each and every employee will be on the alert for an opportunity to further the company's interest, increase its revenue and cut down the cost of operation, because he has ceased to be a cog of a wheel within a wheel and feels that he has a business of his own.

When general managers are trying every means possible to promote efficiency, why not adopt this plan and efficiency will then promote itself. The foregoing did not originate in the mind of the writer by any means but it is the goal toward which the minds of all practical railroad employees are now centered. CHIEF CLERK.

Editor, *Railway Master Mechanic:*

Regarding the criticism of Mr. F. von Bergen in your March issue relative to my article which appeared in the January issue on a "Substitute for Files in Air Brake Work," I am inclined to believe that Mr. von Bergen missed the point, like the boy that went to a lecture on tuberculosis and on returning home was asked by his mother what the subject of the lecture was, replied: "Why it was something about two-bugs-and-a-locust." I think Mr. von Bergen made his test with emery cloth (if he made any) with a prejudiced mind. Emery cloth, if used in place of a file as described in my article, will not cause any trouble on account of particles of emery becoming imbedded in the brass, as this does not occur. In fact the action of the emery is the same as if a file was used. It is well known that *pure* emery is a remarkably tough abrasive, yet has an excellent fracture and is of sufficient hardness to give a fine finish.

As brass is a much softer material than the hard and sharp crystals of emery, a nice neat cut is obtained by using emery for filing, such as could only be secured by the use of a new special square file of very fine cut teeth.

However, such fine cut files do not hold their cutting efficiency very long and have to be cleaned after every stroke or two. Years of experience has taught us that the life of such a file is gone after filing the slide valve seats of about 30 triple valves. If coarser files are used the grinding in of a slide valve requires too much time. I cannot understand how anybody can use the same file for years, as my critic states.

For the last four years we have been doing all our grinding in of slide valves with a machine of our own design. We had remarkable success with this, cutting down the time of labor 95 per cent. But since November of last year we have been facing or filing slide valve seats also by machines, using emery cloth in place of files. I will submit a description of this grinding and filing or facing machine in the near future.

The chief advantages of an emery cloth file over special square files are: First, the repairman has at all times the equivalent of a new file with which to do the work, one little strip of emery cloth being used to file the seats of about four slide valves, except the "L" type of triples, which require more filing; second, the work can be done quicker and the emery cloth can easily be cleaned by blowing a jet of air against it; third, a saving in both labor and materials is effected.

My critic asserts that in some shops he visited, a heavy grease was being used to stop the slide valve from leaking. Any air brake man should know that the seat and face of the slide valve should only be lubricated with

high grade of very fine dry graphite, as this material was found on extensive tests to give the best service.

It appears from Mr. Von Bergen's remarks that some roads do not follow up the recommended practice of the Air Brake Association, which reads that "Triples in which packing rings are to be renewed, slide valves or graduating valves renewed or faced, if the latter are of the slide valve type, should be sent to a central point or general repair station for repairs."

The road with which I am connected does not allow inexperienced men to do triple valve repair work. Air brake work, and more particularly, the triple valve repair work, is kept up to an efficiency equaled only by the best roads in the country. Our management has never spared neither time nor money to provide every means to do this important work systematically, efficiently and economically. We have specialized every branch of it.

As to undesired quick action, the Central of New Jersey is running 365 passenger trains out of Jersey City terminal every 24 hours, having some 700 passenger cars in service. All trains are equipped with the high speed brake, carrying 110 lbs. train line pressure. Yet on all these cars we remove an average of only four triple valves a month on account of undesired emergency applications.

I wish to invite my worthy critic to visit our shops and investigate our method at first hand. If he will accept the invitation we will yet convert him to use emery cloth as a substitute for files.

FRANK J. BORER,
Foreman Air Brake Dept., C. R. R. of N. J.

THE RAILROADS TODAY

One of the great American railway systems, the Pennsylvania, has published a "record," which among other interesting facts reports that its shareholders number 92,225. Nearly half, 44,469 to be explicit, are women. More than half are residents of Pennsylvania and other states directly served by the system.

In public discussion we talk freely of "the railroads" having in mind either soulless legal entities or more or less ruthless and malevolent groups of rich men. We very seldom think of the railroads as properties into which our neighbors, if not ourselves, have put money as an investment just as we may have put money into a house and lot or an insurance policy.

This is natural, for when we think of bad service we direct our thought to the managers while the public evils developed in the history of American railroad stock manipulation have focused attention upon the piracy of would-be overmen of finance.

When to divert this attention and evade punitive measures malefactors have begged us to think of the stockholder, the legitimate investor, of the widow and the orphan, the response has been, naturally again, a contemptuous laugh.

All the same the rights and interests of the stockholder should not be forgotten now or at any other time any more than those of the man or woman who has put money honestly in a business, a piece of land, or any other legitimate enterprise. In the 443 operating roads of the United States the *Railway News* estimates there are 456,231 shareholders, and probably the total including shareholders in leased roads would come to more than half a million. These are the owners of the railroads. In addition there are investors in railroad bonds who must number several hundred thousands.

The Pennsylvania "record" gives the average holding of woman stockholders at 63 shares. As railroad shares are important investments of estates and insurance companies, the livelihood of widows and orphans is therefore in literal truth involved in these securities.

For the wrongs done by high finance shareholders are as a class hardly more responsible than the general public. They have been betrayed by the unscrupulous manipulator, and sometimes their interests have been furthered without their knowledge by methods they would not have countenanced. But now we are passing out of the period of exploitation. The fight for public regulation resulted not only in the creation of agencies to protect the interest of the public, or at least of the shipper, but it also educated railroad men in a policy respecting their responsibilities as quasi-public functionaries which is clearing away most of the evils of the public-be-damned era.

Among the omissions of the late congress was legislation to extend regulation over security issues. Yet railroad financing and financial control are more scrupulous than they have been in some notorious instances in the past, and what is needed now is less talk of evils of the past and more fair consideration of the difficulties of the present. We have to take into account the interests of the shareholder, the employe, the shipper, and the general public. In the narrower sense these interests often clash. Underlying them all, however, is a substantial enduring community of interest in what we call "a square deal." To sacrifice the shareholder's interest means to smother investment in railroad enterprise and slowly paralyze our system of transportation to the inevitable injury not merely of the shareholder but of the whole country and every one in it. To mistreat the employe, to extort from the shipper, each exacts a penalty we all must pay.

At this time the whole country is suffering with and from the condition of the railroads. It is a time for broad views and the burial of animosities, for fair play, and a constructive policy.—*The Chicago Tribune.*

Exchange of Tools

A recent visitor to a storehouse raised the question of the exchange of tools with the storekeeper, and it was found that the general storekeeper was called on each month by the car department for an unusually large quantity of Maydole hammers, that hammer being the standard for car repairing use.

The question was raised as to what practice was followed in procuring the old hammer, or what was done to ascertain disposition of the new hammers issued.

It was conceded that there was no way of checking up the issue of this particlar item, and it is thought to be a subject worthy of investigation, because it is a monthly expense which not only applies to this particular item of Maydole hammers, but many other articles.

The storekeeper took the position that the name of the road was stamped on such hammers, as well as all other tools, and the loss through theft was practically unthought of, yet there was no answer forthcoming as to the unusual consumption. The question of increased forces was gone into, but it did not account for the number required, and there seemed to be no means of knowing whether this particular tool lived out its usefulness.

Will some storekeeper tell us the actual practice in effect at this time, and explain to us so that we may show clearly for the benefit of others just how a check can be had on the issue of this particular tool from the time it is purchased until it finally reaches the destination it should reach, namely, that of the scrap bin?—*Railway Storekeeper.*

Mikado Locomotives for the Georgia R. R.

Engines with All Modern Appliances for Use in Through Freight Service Where Ten-Wheel Locomotives Were Previously Operated

The Georgia Railroad has recently received from the Lima Locomotive Corporation three Mikado type locomotives of heavy, modern design. These locomotives were designed and constructed by the locomotive company from specifications prepared by F. O. Walsh, superintendent of motive power and equipment, and represent the first engines of this type introduced on the Georgia R. R.

The main line of the Georgia R. R. runs between Augusta and Atlanta, a distance of 171 miles. There are 146 curves, the maximum being three degrees, and the aggregate length of the curves is 57.20 miles. There is but seven miles of level grade. There are 131 ascending grades with aggregate length of 96 miles, the total sum of ascents being 2,699 feet, and 113 descending grades with aggregate length of 68 miles, the total sum of descents being 1,786 feet. The maximum grade is 0.7 per 100 ft. or 37 ft. per mile, uncompensated for curvature; that is the rate of 0.7 per mile is also over the curves, which would make the train resistance on 0.7 grade on a 3 degree curve equivalent to an 0.82 grade on straight track.

The design of these locomotives is entirely in accordance with modern ideas of a standard Mikado type locomotive, which can usually be considered as one weighing close to 220,000 lbs. on drivers, and having 63" diameter wheel. The railway company appreciated the necessity of modernizing this standard design, and therefore included in its equipment superheaters, brick arches, pneumatic firedoors, power reverse gears, graphite cylinder lubrication, and other details.

In addition to the other construction features, it may be noted that these locomotives are equipped with the "Economy" front engine truck and the "Austin" radial trailing truck, both of which represent the latest ideas in guiding and trailing devices for large locomotives. The tender is also carried on "Economy" tender trucks, which are the first introduced into this section of the country.

The engines are so far in advance of anything yet in service on the Georgia Railroad that only the service results will give a good comparison as to their general economy in operation. The company previously operated ten-wheel locomotives of quite modern size, having cylinders about 20" diameter. These engines will be used in through service over the company's lines and will be expected to aid greatly in the economic dispatch of the railway's usual business in cotton and fertilizers.

A general plan of these locomotives is submitted to illustrate their peculiar features. It will be seen that they are strongly designed, with heavy frames well cross braced and with large piston valves to distribute the steam to the 27" diameter cylinders. These valves are operated by the Southern valve gear, which is now quite well known in the district in which these engines will operate. This gear is neat in appearance and is reported to be quite effective.

Chambers throttle valves have been applied with outside connection and vertical lever. The auxiliary dome, just back of the main dome, is made in the shape of a manhole to admit of ready inspection of the boiler without taking down the throttle and other appliances.

The Schmidt superheater is of the usual design with steam pipes and is made up of 36 elements.

The frames are very heavily braced at the main pedestal and are equipped with Economy "Cole" patent box, the journal being 22" long, to overcome the pound that generally occurs at that point when a superheating device is used.

Mikado Type Locomotive for the Georgia Railroad.

The air brakes are served by two 11 in. Westinghouse pumps, discharging into reservoirs of 75,000 cu. in. capacity. Steel pilot beams are used at the front end and these are heavily reinforced by a cast steel filling piece which also acts as a guide for the engine truck center pin.

All axles are of heat treated steel.

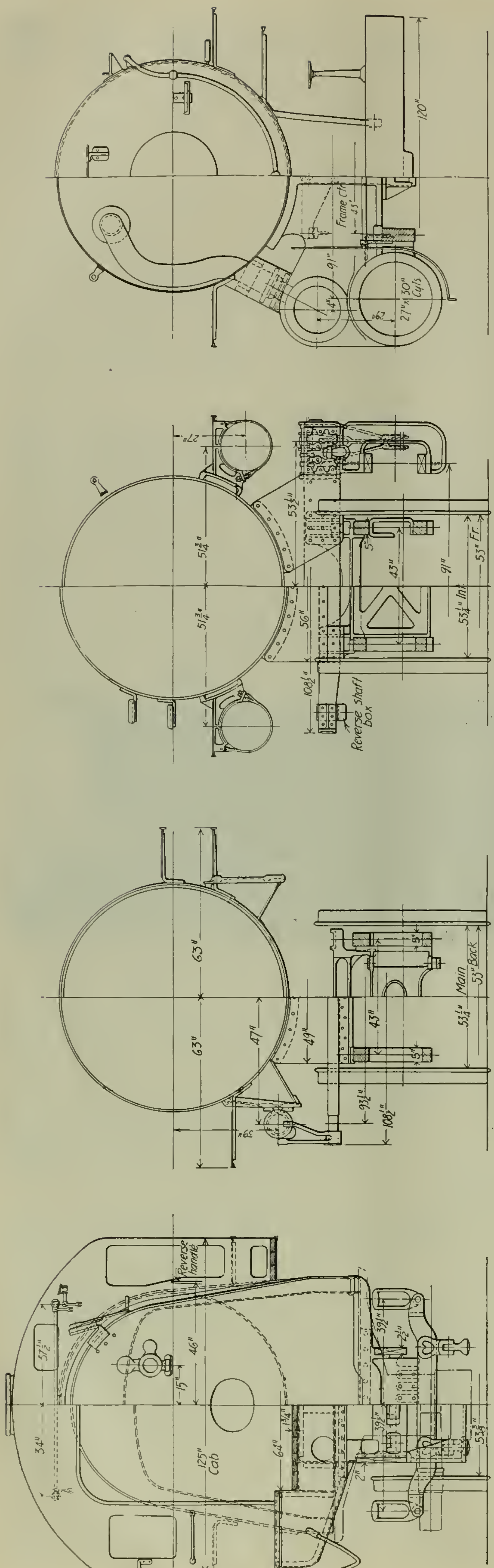
The equipment includes electric headlight, with turbine located just in front of cab.

The water supply is obtained by two Edna injectors discharging into a double top check manufactured by the same company. The strainers are of special design patented by the Lima Locomotive Corporation.

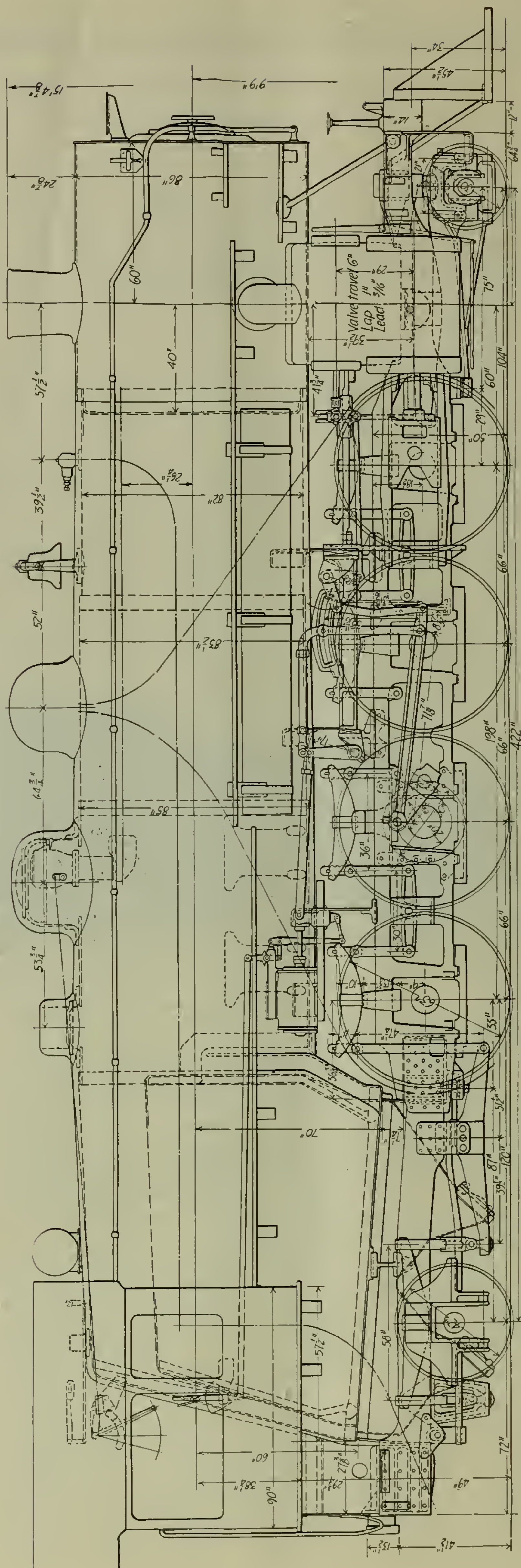
The cab and running boards are of steel plate and the rear deck is of cast steel equipped with Economy radial buffer connection to the tender.

The coal wetting device is supplied by the Edna Brass Manufacturing Company. The 9,000 gallon water tank is of water bottom construction and has a retreating collar of neat design.

Designs for both engine and tender were prepared with the idea of producing an absolutely modern engine of neat and handsome lines, strongly constructed with



Sections of Mikado Locomotive for the Georgia Railroad.



Elevation of Mikado Locomotive for the Georgia Railroad.

a view to maximum service. The arrangement of trucks on both engine and tender should make these engines exceptionally easy riders.

A table of principal dimensions, proportions and ratios is submitted herewith.

GENERAL DATA.	
Gauge	4′ 8½″
Service	Freight
Fuel	Soft coal
Tractive effort	53,200 lbs.
Weight in working order	280,800 lbs.
Weight on drivers	213,000 lbs.
Weight on leading truck	23,200 lbs.
Weight on trailing truck	44,600 lbs.
Weight of engine and tender in working order	454,800 lbs.
Wheelbase—Driving	16′ 6″
Wheelbase—Total	35′ 2″
Wheelbase—Engine and tender	66′ 11¼″
CYLINDERS.	
Kind	Simple
Diameter and stroke	27″x30″
VALVES.	
Kind	Piston
Diameter	16″
Greatest travel	6″
Steam lap	1″
Exhaust clearance	Line and line
Lead	3/16″
Valve gear, type	Southern
WHEELS.	
Driving, diameter over tires	63″
Driving tires, thickness	3½″
Driving journals, main, diameter and length	11″x22″
Driving journals, others, diameter and length	10″x12″
Engine—Truck wheels, diameter	30″
Engine—Truck journals	6″x12″
Trailing truck wheels, diameter	42″
Trailing truck journals	8″x14″
BOILER.	
Style	Straight top, radial stayed
Steam pressure	180 lbs.
Outside diameter of first ring	82″
Firebox, length and width	120⅝″x84″
Firebox plates, thickness	⅜″x½″
Firebox water space	5″ all around
Tubes, material and thickness	Steel No. 11 BWG
Tubes, number and outside diameter	275 2″
Flues, material and thickness	Steel No. 9 BWG
Flues, number and outside diameter	36 5⅜″
Tubes and flues, length	20′ 6″
Heating surface, tubes and flues	3,975 sq. ft.
Heating surface, firebox and arch tubes	262 sq. ft.
Heating surface, total evaporative	4,236 sq. ft.
Superheating surface	865 sq. ft.
Equivalent heating surface	5,533 sq. ft.
Smoke stack, diameter	19″ at choke
Smoke stack, height above rail	15′ 5″
TENDER.	
Frame, type	Steel channels
Wheels, diameter	33″
Journals, diameter and length	6″x11″
Water capacity	9,000 gals.
Fuel capacity	13 tons
RATIOS.	
Weight on drivers ÷ tractive effort	4
Total weight ÷ tractive effort	5.28
Tractive effort × diameter drivers ÷ equivalent heating surface	600
Evaporative heating surface ÷ grate area	60
Firebox heating surface ÷ tubes and flue heating surface	6.6%
Weight on drivers ÷ equivalent heating surface	38.5
Total weight ÷ equivalent heating surface	52.7
Volume both cylinders, cubic feet	19.86
Equivalent heating surface ÷ cylinder volume	268
Grate area ÷ cylinder volume	3.54

A Good Record on the Grand Trunk

During January and February, 1915, there were twenty-nine cases of injury to employes on the Grand Trunk and Grand Trunk Pacific. Only four of these injuries were at all serious, and probably not all of these four will be permanent. This is indeed a good record—3,000 miles of railway operated for two winter months, when weather conditions were unfavorable—with only four employes seriously injured.

Preventing Accidents With Hand Tools*

Small Tools Are Not Regarded as Dangerous as Machinery but They Often Cause Distressing Accidents

Personal caution is the greatest safeguard, whether observed in the general and apparently important affairs of industrial life or applied to specific and seemingly trivial details. A spill from a 20-ton ladle of molten metal may cause a serious burn, yet a chip struck from the battered head of a 20-cent chisel may result in blindness to an employee. A defective weld in a crane chain may allow a load to "let go" with disastrous consequences, while the use of a weak, cross-grained or splintered sledge handle may let the sledge fly across the shop and injure workmen who may be in its path. Considerable injury may also be traced to the use of loose-fitting wrenches, splintered or broken shovel handles and to other uncared-for hand tools. The care of tools of this class as regards safety is discussed in a recent safety bulletin issued by the National Founders Association.

The largest contributors to injuries in the latter class are chisels, punches, wedges, blacksmith's tools, stonecutter's tools and similar small hand tools which are subjected to frequent hammer-blows, in consequence of which their heads become readily "mushroomed." A mushroomed head presents a dangerous condition, for the next hammer-blow may break off one of the slivers of steel hanging to the body of the tool and send it flying through the air, with great risk of injury to the man handling the tool, or to others nearby. The remedy is well known, simple and effective. When the head of such a tool is found to be chipped, cracked or muchroomed, it should be promptly laid aside and not used again until the head has been ground down or dressed to its proper shape. A good practice applicable to cold-chisels and other tools that must be sharpened frequently is to grind down their heads every time the tools are sharpened, thus preventing the development of a mushroomed condition, at the same time retaining the hammer-hardened ends which will not spread so rapidly in the future life of the tools; this practice also avoids much waste of the steel which would otherwise have to be cut off if the heads of the tools were re-forged. As a further precautionary measure, all steel hand tools that are liable to be struck by hand hammers or sledges should have the upper part of the shanks shaped round and slightly tapered from the top downward before they are used at all; care should also be taken to make such tools of the right grade of steel, else the battered. overhanging portions of the tools will readily break off.

The heads of chisels used in pneumatic tools are usually hardened and will chip easily when struck with an ordinary hammer; such chisels should never be used in this way.

The character of hammer and sledge handles and their method of fastening is worthy of more than passing notice. If not straight-grained or if the wood used is "short" in texture, it must be expected that such handles will quickly splinter and break; if attached in a slip-shod manner, or if insecurely fitted, or if wedged by nails instead of wedges, or if the handle is watersoaked so as to swell and become only temporarily tight in the hammer head, it is obvious that these ill-fitted handles will become loose, and that the hammers or sledges will fly off when the nails loosen up or when the handle dries and shrinks. When it is recognized that the peculiar function of hammers and sledges is to strike blows with considerable force, it becomes clear that there is no economy in cheap but weak handles, and that all handles

* An article in the January issue of Industrial Engineering.

should be carefully purchased and properly fastened in place.

The use of defective file or screw driver handles also contributes to the sum of injuries caused by hand tools. When such handles are split the handle end of the file or screw driver is apt to be forced through the handle and puncture the user's hands; when these tools are used without handles similar injuries sometimes result. The use of only the best handles is a safe as well as an economical measure.

When smooth-faced hammers or hatchets are used for driving nails, the nails frequently glance and strike persons who are working in the vicinity. This danger can be minimized by the use of hammers or hatchets with their faces roughened.

Wrenches are wrongly used and abused, sometimes because the management is over-economical, but usually because the employee is too lazy or impatient to secure the right wrenches for the job in hand. Solid wrenches that are too large for the nut or bolt-head are soon worn into a rounded shape that allows them to slip and bruise the workmen's hands, also spoiling the shape of the nut or bolt-head, which in turn presents an added risk of the same kind. Wrenches of the right size but worn beyond the possibility of giving safe and effective service, cause similar injuries. Again the remedy is simple and even economical; the wrenches should be ground or milled to suit larger size nuts, or if there is too little stock left, they should be scrapped. Monkey wrenches or Stillson wrenches with bent jaws or worn adjusting parts, are also apt to cause injury by slipping; such wrenches should be repaired or replaced. Wrenches are cheap; when in good condition they are not only safest, but do more and better work than the faulty variety.

Another tool in common use which has contributed a large quota of accidental injuries is the pinch bar used to pry heavy bodies short distances or to "pinch" cars to a new position on their tracks. These tools are bound to slip occasionally, when they are apt to bruise or crush the user's hands. A disc attached to a pinch bar would protect the workmen's hands from injury if the bar should slip. This safety device also lends confidence to the user and thus promotes more rapid work.

The rapidly growing use of electricity for power and light requires that workmen should be instructed to use proper tools when making adjustments on electrically charged apparatus. Screw drivers, pliers and other tools used for this purpose must be insulated. When the voltage is more than 110, insulated tongs made of hard fibre or other non-conducting material should be provided for safely removing or replacing fuses.

Some effective system should be adopted and carefully followed in each shop to prevent the user of improper or defective handles or tools. Only such handles and tools should be purchased or put into service as are safest and best for the purpose. Even these may in time become unsafe by wear; it therefore becomes imperative that they should be inspected regularly and their safe condition maintained. In shops where such tools are turned into the tool-room or stock-room every night the storekeepers can be instructed to re-issue only such tools as are safely fit for service. Where such tools are kept out for longer periods, the foreman or a sub-foreman in small shops, or a regularly appointed inspector in large plants, should see to it that defective tools are turned in promptly for renewal or repairs. In some plants the foreman or inspector condemns such unsafe tools by wiring a red tag to them.

Furthermore, the danger of using defective tools must be impressed upon the workmen from day to day, for the matter will not take care of itself.

STEAM RAILWAY ELECTRIFICATIONS

The Western Society of Engineers held an electrification meeting on March 16, and the large attendance was favored with four papers covering some of the most important electrification projects in the country, namely, those of the New York Central, the New York, New Haven & Hartford, the Chicago, Milwaukee & St. Paul, the Norfolk & Western and the Philadelphia terminal of the Pennsylvania.

The Norfolk & Western electrification project was described by George Gibbs, of the firm of Gibbs & Hill, consulting engineers. This project is for heavy freight service through the Allegheny mountain district, the primary purpose being to increase the capacity by increasing the operating speed. The line is double track with frequent long passing sidings and 60 per cent of the division is on curves. The east-bound coal traffic frequently amounts to 60,000 tons per day and at present the number of these tonnage trains is about 12 per day. With electrical equipment provision has been made for handling 20 trains per day. With steam operation it was customary to make up a train to a maximum weight of 3,250 tons behind the engine. This train was handled with a Mallet road engine and a Mallet helper, and in addition a Mallet pusher up 1½ and 2 per cent grades. These engines were compounded and fitted with stokers and superheaters and the trains were handled normally at a speed of from 7 to 8 miles per hour on grades. In electrifying, the single phase, alternating current system was adopted and three-phase motors were adopted for the locomotives, the required current being produced by a "phase converter." The electrical installation comprises 29 route miles of track or 97 track miles with an overhead trolley operating at a voltage of 11,000. Twelve locomotives have been provided, weighing 270 tons each. They have a drawbar pull varying from a maximum of 11,400 pounds during acceleration at 14 m. p. h. to 86,000 pounds when operating at this speed uniformly on a 1 per cent grade. The locomotives are divided into two halves and have a length over all of 105 ft. 8 in., with a rigid wheel base of 11 ft. The heavy grade portion of this electrification from North Fork to Flat Top yard has been in operation a number of weeks and the results forecast an entirely successful operation.

Mr. Gibbs also gave a brief description of the suburban electrification work of the Pennsylvania at Philadelphia. The growth of the company's business has been such that the capacity of Broad street station has been reached and after carefully considering many plans it was decided to electrify the suburban lines, which would be equivalent to reducing the total number of trains for the station as a whole by about 8 per cent. It is estimated that the relief will take care of normal growth for about four years. The single phase, alternating current system with overhead contact wires was chosen. The fact that the New York terminal is operated by the third rail, direct current system was not a serious objection as the mercury arc rectifier has been thoroughly developed to take care of this situation. The route miles electrified are 20.3 and the track miles, 86.1. The number of trains per day both ways are 84 and the schedule speed, including stops, is 24 m. p. h. The project will be completed late in May. Mr. Gibbs' remarks were illustrated by lantern slides.

The electrification of the western lines of the Chicago, Milwaukee & St. Paul were described in a comprehensive paper by C. A. Goodnow, assistant to the president, who has this work in charge. An extended description of this project was given on page 15 of the January, 1915, issue of the *Railway Master Mechanic*.

Edwin B. Katle, chief engineer of electric traction, New York Central R. R., presented a paper giving some general cost figures and other data on the electrified lines of that road. A large number of records show the average cost of steam locomotives for all classes of service to be about 26 cents per mile. Costs for electric locomotives in New York City are about 21 cents per mile. Adding fixed charges, however, the cost becomes 30 cents per mile for steam locomotives and 60 cents per mile for electric locomotives. These figures are only approximate and indicate the tendency. The average cost for maintenance of electric locomotives, including inspection, repairs, renewals, cleaning and painting for the past eight years has been around 3½ cents per mile. Multiple unit trains are used, with two motor cars to one trailer. The maintenance cost per car mile, excluding only sweeping and window cleaning, has averaged less than two cents. The cost of maintenance of the special protected third rail used has averaged about $26 per mile per month on the main line and $40 for yards and terminals. The average total cost of current delivered to the shoes of the equipment is about 1¾ cents per kilowatt hour.

W. S. Murray, consulting electrical engineer of the New York, New Haven & Hartford, presented a paper on "The Advance of Electrification," extracts of which are published elsewhere in this issue.

Many well known engineers took part in the discussion and the meeting was a success in every way.

Increased Roundhouse Expenses

Recent Regulations and Improvements Which Have Placed Additional Burdens on the Roundhouse, Together with a Few Efficiency Suggestions

By W. S. Whiteford, Genl. Fmn., C. & N.-W. Ry., Milwaukee.

After the engine has been turned out of the back shop and broke in, it is turned over to the roundhouse and the foreman is expected to get the required mileage before going to the back shop again. It means a great deal to him to get the engine from the back shop well repaired. For example, when an engine goes to the back shop and comes out with the work slighted, such as journals in poor shape, driving box brasses loose in the boxes or on the journals or numerous other things that are likely to be slighted in the back shop by the foreman who is anxious to get his output. The roundhouse will have trouble from the start and it will continue until the roundhouse foreman is forced to take the engine in and place over drop pit and make the necessary repairs, which should have been done in the back shop. These things also go toward increasing the roundhouse expense and reducing efficiency.

There have been a great many improvements applied to the locomotive of late, which have had a tendency to increase the work in the roundhouse, although they have increased the efficiency on the road and elsewhere. For instance, the power is much larger and parts heavier and more awkward to handle, but of course this has been overcome to a great extent by special devices and jigs, and by standardizing the parts. Incidentally I believe that one of the biggest savings a company can effect is to standardize locomotive parts. The power has grown beyond the capacity of most roundhouses, but modern houses are being built as fast as possible and they reduce expenses considerably. The old saying is, "You can't get blood out of a turnip," and it is hard to get efficiency from a roundhouse with but twenty or twenty-five stalls and perhaps only half of these stalls large enough to accommodate a Pacific type engine, when you have from 100 to 110 engines to turn daily. This takes more dispatchers and engine watchers, as engines have to stand outside and consequently burn more coal.

The Federal boiler law has also increased our expense as the attention of a boilermaker is required almost constantly and a machinist and helper part of the time. I figure this item alone costs us from $75 to $100 per month, and on every third month or quarterly test, it will cost about $45 more. The electric headlights cost us about $75 more per month (this is of course labor in the roundhouse) for their maintenance, and this cost will increase as the generators grow older.

While the locomotive superheater has wonderfully increased the efficiency of the locomotive on the road, it has caused more expense and work for the roundhouse, although this little increase in the roundhouse expense is nothing compared to what it has done toward the saving of coal and water on the road.

The standard safety appliances are required by law to be applied to each locomotive by a certain time, and most of this work falls upon the roundhouse force. It has also been required by law that all road locomotives in Wisconsin and Dakota be equipped with the electric headlight, and this was done by the roundhouse forces, which helped to increase the expense at this point.

The changing of our lubricators from the tubular to the bulls-eye, and changing water glass cocks and shields, are also items, the greater share of which was done in the roundhouse. All these things and numerous others have increased our expense in spite of the numerous things we have done in scheming and getting up devices to overcome this increase.

Some of the things we are doing in this line are the use of kerosene instead of gasoline; also by the use of a double hoop in tire changing they can be heated just as quick, thus saving the difference in the price of the two articles. The Markel devices especially the solid back end main rod, have reduced our expense at least 50 per cent in repairs and 50 per cent saving on metal. The removable driving box brasses, flangeless shoe and wedge, also the lateral motion plates, have certainly been a great help to the roundhouse. The electric and acetylene welding processes are doing a wonderful part in helping us to reduce our expense.

The roundhouse foreman should know his men and know just what each one is best fitted for, as one man may be better on a machine than he would be on the bench or floor.

The work should be specialized as much as possible, one man to look after wedges, another to follow up the engine inspector and do all the work that the inspector may find, and I will guarantee he will be kept busy. Regular men should be assigned to running repair work, dead work or shop work, machine work, injectors and lubricators, air brake work, etc. Work specialized in this manner will mean a great deal toward efficiency.

There should be an outside labor foreman with sufficient number of men to do the necessary work, such as unloading of sand, wood, material and to keep the yard and house neat and clean. He should also load the scrap, but should not do so without the foreman, his assistant or some competent man to look same over and see that no usable material is allowed to be hauled away. A large amount can be saved by watching the scrap bins.

The Georgia commission has passed an order approving the general plans for the new union depot at Macon, Ga., and has instructed the Macon Terminal Co., which is to build the new station, to submit complete specifications to the committee not later than September 15, of this year. The terminal is to be completed in twelve months from that date.

Results of the Boiler Inspection Law*

A Review of the Federal Lomomotive Boiler Inspection Work Shows Gratifying Results in Promoting Its Purpose — Safety

By Frank McManamy,
Chief Inspector, Locomotive Boilers, Interstate Commerce Commission, Washington, D. C.

A resume of the work of the locomotive boiler inspection service during the three years and eight months since the law became effective shows results for which we have not one word of apology to offer. The following table shows in concrete form the inspection work performed each year since the passage of the law; and the decrease in the percentage of locomotives reported defective indicates in a measure the improvement in conditions:

	1914	1913	1912
Number of locomotives inspected	92,716	90,346	74,234
Number found defective	49,137	54,522	48,768
Percentage found defective	52.9	60.3	65.7
Number ordered out of service	3,365	4,676	3,377

It does not, however, fully show the improved conditions resulting from the operation of the law, because, as pointed out in our 1913 report, our attention was first concentrated on the more serious defects, so that the number of fatalities might be reduced; therefore, the improvement is more accurately indicated by the reduction in the number of casualties, as shown by the following table:

	1914	1913	1912
Number of accidents	555	820	856
Decrease from previous year.......per cent	32.3	4.2	...
Decrease from 1912.......per cent	35.1	...	...
Number killed	23	36	91
Decrease from previous year.......per cent	36.1	60.4	...
Decrease from 1912.......per cent	74.7	...	...
Number injured	614	911	1,005
Decrease from previous year.......per cent	32.6	9.3	...
Decrease from 1912.......per cent	38.9	...	...

The data shown above is taken from the records up to July 1, 1914. A check of the first six months of the present fiscal year, that is from July 1, 1914, to January 1, 1915, in comparison with the corresponding period in the preceding year shows that during the period ended January 1, 1914, there was a total of 349 accidents which resulted in injury, with 15 killed and 385 injured thereby. During the period ended January 1, 1915, there was a total of 253 accidents which resulted in injury, with 6 killed and 271 injured thereby, or a decrease of 27.5 per cent in the number of accidents, 60 per cent in the number of killed, and 30 per cent in the number injured by the failure of locomotive boilers and their appurtenances.

Going back further and making a comparison with the corresponding period for 1912, we find that during the six months' period ended January 1, 1913, there were 470 accidents which resulted in injury, with 24 killed and 512 injured thereby. In other words, the number killed by failure of locomotive boilers and their appurtenances during the first half of our fiscal year which began on July 1, 1912, was 12½ per cent greater than for the corresponding periods in the two following fiscal years, with almost as great a decrease in the number injured and the number of accidents. Or, to state the whole matter briefly, in three years the number killed by failure of locomotive boilers and their appurtenances has been reduced from about 100 per annum to less than one-fourth that number, and the number injured from more than 1,000 per annum to less than one-half that number, with a corresponding decrease in the number of accidents.

These are the direct results of the operation of the locomotive boiler inspection law, and indicate the manner in which it is fulfilling the purpose for which it was enacted: namely, to promote safety. The question will no doubt arise as to just what the law has done to produce such results. The results are due to a number of reasons, among which are more careful inspection, more prompt repairs and attention to minor defects, investigation and classification of every accident that resulted in injury, with a view to determining the cause and remedying it, and giving publicity to the information collected.

No railroad man with a trace of honesty and a knowledge of conditions and practices prior to the passage of the law can question the fact that, generally speaking, inspections are now made more carefully and more regularly, and repairs are more promptly made, and further that the question of repairs is less apt to be determined by the number of loads in the yard awaiting movement, although unfortunately that is still occasionally considered to be the deciding factor; an illustration being a recent request by a master mechanic to operate a locomotive with 43 broken staybolts a distance of 312 miles, because they needed the power. It must be admitted, however, that such instances are becoming more rare, although we still occasionally find a superintendent or trainmaster who, in spite of the fact that he is at the other end of the division, considers himself a better judge of the condition of a locomotive than an inspector or foreman who is on the ground, and orders it into service regardless of its condition.

The importance of giving attention to minor defects can be shown by a single illustration. During the last fiscal year 18 persons were injured due to studs blowing out of firebox or wrapper sheets. The practice of repairing leaky studs by caulking, or permitting them to continue in service without repairs, should be discontinued.

I have recently had occasion to read very carefully statements made before Congressional committees at the time the boiler inspection law was pending, to the effect that all boiler explosions were really crown sheet failures due to low water; therefore, were man failures. In order to correct this misapprehension, attention is directed to the records of such accidents since July 1, 1911.

During the year 1914, as compared with 1912, accidents which are usually termed boiler explosions which resulted in injury have decreased 44 per cent, or from 97 in 1912 to 54 in 1914, and the number of killed and injured has decreased 64 per cent, or from 290 to 104. During the same period crown sheet failures due to low water decreased 48 per cent, or from 92 to 48. I am directing attention especially to this class of accidents, first to show that the class of accidents which were said to be unpreventable have been materially reduced, and also because our investigations have shown that by proper application and maintenance of boiler appurtenances they can be still further reduced.

Rule 42 provides that, "Every boiler shall be equipped with at least one water glass and three gauge cocks. The lowest gauge cock and the lowest reading of the water glass shall be not less than 3 in. above the highest point of the crown sheet." While it may be a compliance with the letter of the law to locate these appurtenances where they can be most easily applied, regardless of their con-

* A paper delivered before the Western Railway Club.

venience to the enginemen, it is manifestly not a compliance with the intent of the law, and is not conducive to safety, as an improper or inconvenient location may seriously interfere with their proper use. A certain type of locomotive has the water glass located directly behind the engineer and entirely out of sight of the fireman. In other instances glasses are found so obscured by other boiler appurtenances or by an improper shield that it is difficult, and under certain conditions impossible, to see the water level. A recent investigation of a crown sheet failure showed that the cab arrangement was such that the water glass and gauge cocks were 9 in. above the engineer's head and that he regularly carried a small keg to climb upon to try the gauge cocks. Can it be seriously questioned that such conditions cause accidents, particularly when operating in a busy terminal? Using a shield that obstructs the view of the water glass is also too common. The manner of application is also important, both as to water glasses and gauge cocks.

We also find that the manner in which gauge cocks and gauge cock drippers are applied indicates that the purpose for which they were applied did not receive sufficient consideration. While the application of a dripper is important to prevent the discharge from the gauge cocks from scalding anyone in the cab, it should not be located so close to the gauge cocks that the nipples extend down into the dripper, preventing enginemen from seeing the discharge, as dripper pipes occasionally become obstructed and fill with water, in which event the sound of water and steam are identical.

Failure of injector steam pipes continues to be one of the most frequent causes of serious accidents, and is the only one which shows an increase during the present fiscal year over the corresponding period for the previous year. To bring out clearly the cause of these failures, the following is a complete list of all that have occurred since July 1, 1914, and which resulted in 1 killed and 15 injured, showing the cause of each:

INJECTOR STEAM PIPE FAILURES, JULY 1, 1914, TO MARCH 1, 1915.

1. Collar broke on right injector steam pipe, due to old crack in collar.
2. Steam pipe to left injector blew off where brazed to collar.
3. Injector steam pipe blew off; union nut broke while being tightened under pressure, due to defective nut and use of improper tools for making repairs.
4. Threads stripped in injector steam pipe union nut while being tightened under pressure; nut too light and threads badly worn.
5. Injector steam pipe blew off; union nut broke while being tightened under pressure.
6. Union to left injector steam pipe blew off, fatally scalding fireman who was attempting to tighten it under pressure; spanner nut too large.
7. Steam pipe to left injector pulled loose at turret connection due to defective brazing and injector not properly braced.
8. Left injector steam pipe collar broke at injector throttle connection; old crack in flange of collar and wrapped with asbestos to stop leak.
9. Injector steam pipe collar broke; defective collar.
10. Injector steam pipe spanner nut broke while being tightened under pressure.
11. Spanner nut on injector steam pipe broke while being tightened under pressure. Nut had been badly damaged previous to accident by use of hammer and set.
12. Injector steam pipe pulled out of collar; improperly brazed.
13. Spanner nut on left injector steam pipe broke while being tightened under pressure; due to use of improper tools.
14. Injector steam pipe broke at brazing.
15. Right injector steam pipe collar broke; defective collar.
16. Injector steam pipe collar broke; defective collar.

The nine failures, four of which were due to poor brazing and five to collar or sleeve breaking, can, I believe, be prevented by extending the pipe through the collar or sleeve and flanging or beading it, thus reinforcing the collar and reducing the strain on it, as the end of the pipe itself will be solidly held in the joint; therefore, it will carry the load. If properly applied in this way, brazing is not necessary, although it can be done if desired. This method of application is at least as cheap as brazing, and defective or improper workmanship can be discovered by inspection, which is impossible with the brazed connection.

In view of the statements occasionally made relative to the expense to the carriers of complying with the Locomotive Boiler Inspection Law, it may be pertinent to inquire if proper entries are always made on the credit side of the ledger and a trial balance taken. I will confess that we do not feel ourselves competent to place a value on human life; but an estimate based on the average cost to the carriers of an accident resulting in the loss of a life multiplied by the decrease in the number of such accidents during the past three years will be at least as nearly correct as the average estimate of the cost of the law, and will give a substantial item to start with. As injured employees usually receive pay from the company or compensation from the relief department for the time lost, an estimate of the saving from this source based on the decrease in the number injured would be another important item.

There are other results, more or less indirect, but of substantial benefit to the carriers, among which are a reduction in the number of engine failures, as we have numerous records of locomotive performance which show an increase of from 200 to 800 per cent in the miles per failure since the law became effective, which it is admitted is largely due to improved conditions resulting from the stimulating effect of the law. A saving in fuel is another result of the improved conditions brought about by compliance with the requirements, among which are prohibiting the use of fire plugs and providing that boilers must be more carefully washed, and must have all scale removed when in shop for repairs, and that leaks both in and outside of firebox must be kept down to the minimum.

In this connection it is not out of place to state that few, if any, railroad men realized the extent to which the use of flue plugs had been carried prior to the passage of the law. It is true their use was admitted to be general, and our records of the bearings prior to the approval of the rules contains numerous statements made by prominent mechanical officers that a rule prohibiting the use of flue plugs would cripple their road.

Failure to properly wash and scale boilers is another evil which has grown to alarming proportions, due perhaps to the fact that washing or scaling a boiler is among the most disagreeable tasks around a shop, and is too often performed by incompetent or indifferent labor not properly supervised. In addition to being one of the chief causes of leaking crown and staybolts, tests have shown that 1/8 in. of scale on heating surfaces results in a loss of approximately 15 per cent of the value of the fuel; therefore, clean boilers mean in addition to increased efficiency a saving in cost of fuel as well as in the cost of repairs.

While it can not be doubted that the remarkable decrease in the number of casualties and the improved conditions noted, as well as many others, are a direct result of the operation of the law, I do not wish to be understood as claiming that those who are administering the law are entitled to all credit for the improvement shown. Such results could not have been accomplished without the co-operation of the railroad officers, which we have in a great measure received. However, co-operation does not mean that we should ignore defective conditions and permit locomotives to remain in service in violation of the law, and that will not be done; it does not mean that attempts should be made to conceal defects by making improper inspections or by certifying to reports which do not represent actual conditions.

FACTORS IN SUCCESSFUL PIECE WORK*

By E. J. Thill, Piece Work Foreman, N. Y. C. R. R.

The greater part of my railroad career has been spent in the handling and supervision of piece work, and needless to relate, I have had my troubles, which is quite natural with the installation of a piece work system. This is due to the fact that men will be found in all shops who are adverse to the system.

While I have never heard the term "piece work" defined, in my opinion an excellent definition would be "greater output per operator, at less cost per article, and greater earning rate per hour of operation."

With respect to the day work system, I believe we will all have to acknowledge that its tendency is to bring the superior workman down to the level of the inferior. This is virtually placing a premium on inefficiency and therefore is opposed to the attainment of desired results.

On some of the Western railroads they have a system in operation known as the "bonus system," whereby a workman receives a bonus in addition to his daily rate of pay. This bonus I understand consists of a part of the increase earned by the operator by reason of an increased output, due to increased efficiency and diligence on his part. While this system may give better results and bring better returns to the men than the day work system, it does not seem possible that it will provide maximum output per operator, minimum cost per article, and maximum earning rate per hour, per operator, such as would be attained under a proper piece work system.

As regards the advantages derived from an efficient piece work system, I want to make it plain that there are three potent factors in the successful handling of same These are, respectively: Efficient piece work inspectors, peace of mind on the part of the workmen, and a schedule that can be readily understood by the men, who might be lacking a little in ordinary education.

Peace of mind on the part of the workman is absolutely necessary for him to do his best under any system. This should be considered in the light of the fact that the piece work operator is often justly suspicious of the piece work inspector. If there is one thing that will put a piece work operator out of sorts, it is the slightest doubt as to whether he has received proper reimbursement for his labor. Therefore a great deal depends on the piece work inspector, as the average workman is no mathematician, and generally has an innate suspicion of the piece work inspector, in that he is not reasonably sure that he has received proper returns for the work performed. For this reason the piece work schedule should be one that can be easily interpreted and understood, and combination prices eliminated.

The other two factors in an efficient piece work system rest with the management, and make it possible for the success of the one just described.

Extreme care should be exercised by piece work inspectors to see that the men are fully compensated for the work performed, and in the matter of piece work prices, to see that the workman is rightfully compensated under the conditions he is working, and that the company obtains the desired results. A piece work price should not be installed where in the vernacular of the operator, "the piece work inspector cannot back it up." In other words, he should never set a price under given conditions unless he can produce men from the working force who can demonstrate that the price is right and good for an increase of about 50 per cent or more over the day rate. Then should a workman question the fairness of a price, he can be shown that the same is productive of increased earning capacity, and will readily see that piece work is of great benefit to him. These are the results obtained under a proper piece work system and are conditions that appeal strongly to the operator.

Right here, I want to ask, did you gentlemen ever stop to consider of what little importance you are alone? How little you would amount to if it were not for the association and co-operation of others. What would the tools and machinery of an institution or shop amount to if it were not for the men in the ranks who operate them?

In this sense a piece work inspector should take the operator into his confidence and give him the consideration of knowing something. Show him how his earning capacity can be increased and how both he and the railroad company can be benefited. Then you will derive from the workman the full benefits accruing from co-operation.

I have heard the statement made frequently with respect to certain individuals who have gained recognition; "He was a good man, but could not handle them." He had climbed the ladder of success, step by step, until he reached the point where he was put in charge of men, and there he stopped. He failed to strengthen that point, which resulted in his downfall. Therefore in striving for advancement the matter of executive ability should not be overlooked. It is something you cannot learn at college or from books. In order to become proficient in handling men you have got to be out among them and understand their failings and weaknesses.

A thorough piece work system would give the shop superintendent every detail necessary to enable him to know where he was at, in any department of his shop. As regards getting the best possible results from an operator by reason of his knowing that his record is known to the management, that is also covered.

Every man working in a shop under a proper piece work system knows that it is wise to study at all times ways to get his work out quicker, as he realizes he will be benefited thereby. That is to say, he is aware that the shop superintendent and his foreman are anxious to co-operate with him along these lines, and that he will not be penalized for using his brains in having the piece work price cut, because by his increased output he is decreasing the cost of production.

In my estimation, piece work can never be handled successfully if the management will allow the prices to be cut as soon as they become remunerative to the workman, or in shop parlance, "when he lets himself out a little in response to a tempting rate." Nothing is more discouraging to him than this price cutting for no other reason than increased efficiency on the part of the operator. Therefore it behooves the piece work inspector when making prices to use the utmost care and caution to note the conditions under which the man is working.

Where men are put on piece work, the shop equipment should be of such design and quality as will offer best results and should be kept up at all times, because the placing of a poor tool in the hands of a good workman is just as improper as giving a good tool to one who is not proficient, for in neither case are the desired results accomplished.

I want to emphasize the fact that where a shop is working under a thorough piece work system, there is no question about its efficiency, as in my opinion, piece work is a synonym for efficiency.

* A paper delivered before the Niagara Frontier Car Men's Association.

The Norfolk & Western has prepared plans for a roundhouse, engine shop, turntable and railroad yards at Hagerstown, Md., it is said.

THE BOILER CODE COMPLETED

A signal event for the boiler industry and one that means much to the field of power production in general, was the completion of the report of the committee of the American Society of Mechanical Engineers to formulate standard specifications for the construction of steam boilers, and its approval by the council of the society.

The work involved in the final revision of the code was one of the most strenuous and trying committee undertakings ever carried out in the history of the society. The work of revision began on December 15, 1914, and was carried on continuously without interruption until February 3, 1915, covering a period of nearly eight weeks of the most exacting and painstaking work. A notable feature of the final revision was the amount of research work involved, several series of tests having been carried out by members of the committee to check and establish the authenticity of the rules and formulae embodied in the code.

The work of the committee was confined to rules for construction of steam boilers only. The result of the work of revision of the construction rules was the division into two parts, one for new installations and the other for existing installations, and following this was provided an appendix in which were placed the rules, examples, illustrations, references and data that were in nature supplementary to the rules. As now laid out, the rules for existing installations cover all details of construction of new steam boilers and the rules for allowable working pressures upon them, the details being referred to in the following order: Materials of construction, including the material specifications, maximum allowable working pressures, boiler joints, braced and stayed surfaces, combustion chambers, tubes, riveting and calking, manholes and handholes, safety valves, water and steam gauges, and fittings and appliances. At the end of Part I is a section devoted to heating boilers, in which the above order of subjects is also adhered to. In Part II, which is devoted to existing installations, the same order of subjects is followed, although less complete and exacting in details. The rules of course do not apply to boilers which are subject to Federal inspection and control.

The code is finding immediate application. The state of Indiana is considering the matter and it is very probable that an amendment will be passed by the legislature rendering the former Indiana boiler code optional, with the proviso that the A. S. M. E. code may be used for boiler construction in place of the present state code if desired. The Ohio State Boiler Board has the new code under consideration and it is possible that it will be adopted in place of the boiler code now in force in that state. In Wisconsin the code will probably take immediate effect as a result of an action of the Industrial Commission of Wisconsin taken last year looking forward to the A. S. M. E. code before it was completed; while a preliminary set of boiler rules were put into effect in that state the first of this year, provision was made for their replacement by the A. S. M. E. code as soon as finished. Copies of the code may be obtained from the secretary of the society, 29 West 39th street, New York, at 80 cents per single copy or 30 cents per copy in lots of 1,000 to 2,000.

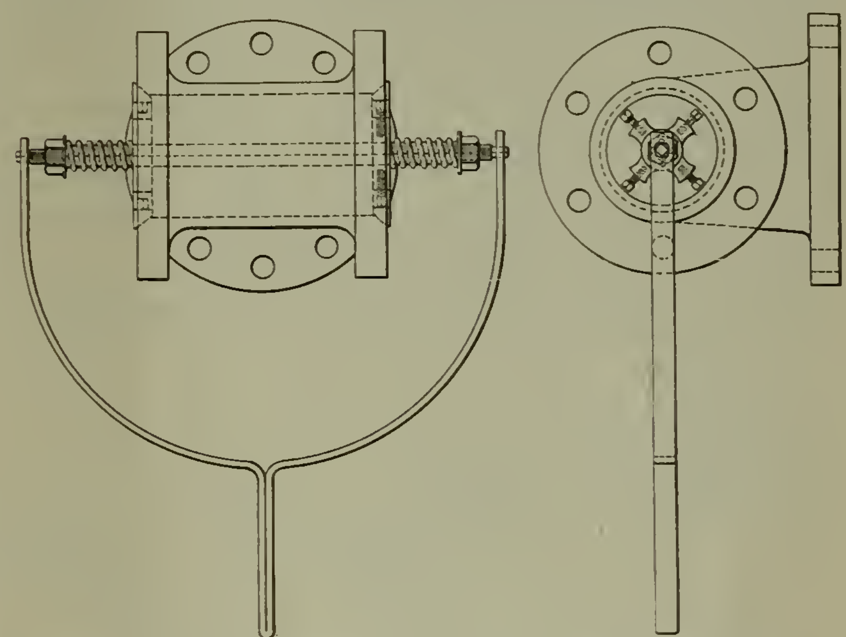
The original members represent the exceptional wisdom and foresight of the officials of the society in their concern that all the various branches of the industry should be represented. John A. Stevens, a consulting engineer of extended power plant experience, who was appointed chairman, offered the advantages of his experience in formulating the Massachusetts code, the first state boiler code that was put into effect in this country. R. C. Carpenter and E. F. Miller, professors of engineering, came as representatives of the steam boiler users; E. D. Meier and Richard Hammond brought in the fund of experience that only long experience in boiler manufacturing rendered possible; Chas. L. Huston was particularly valuable to the committee as a manufacturer of steel boiler plate and an investigator in the scientific manufacture of iron and steel plate, and Wm. H. Boehm, an insurance engineer, brought to the committee valuable suggestions as a representative of the field of boiler inspection and insurance.

GRINDING IN NIGGER HEAD RINGS

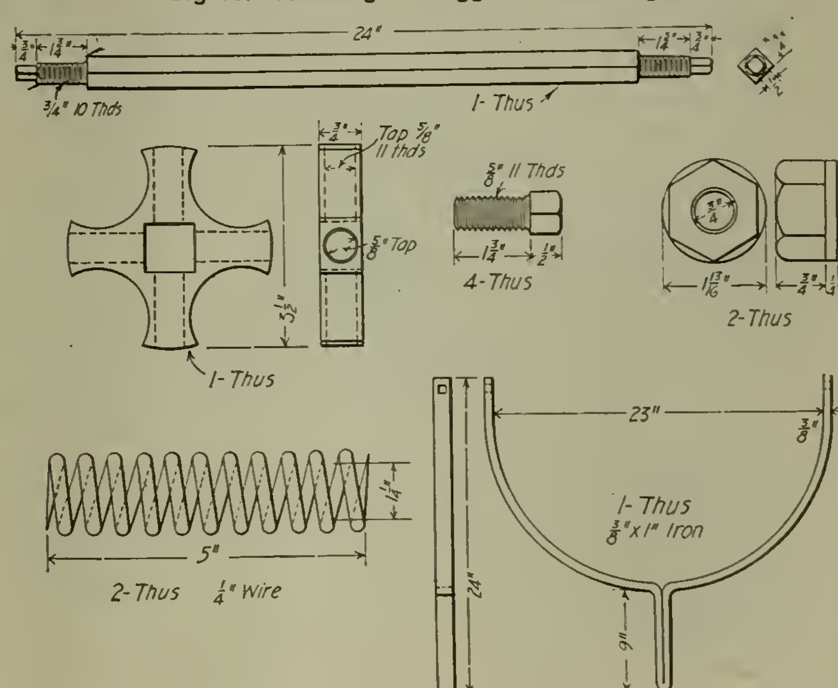
By Chas. Markel, Shop Fmn., C. & N.-W. Ry., Clinton, Ia.

A large number of shop and engine house repairs involve removing only the steam pipes, which leaves the nigger head in place at the front of the flue sheet. The illustrations show a very handy home-made jig that is considered a time and money saver at the Clinton shops and engine houses. Before this jig was made we had to grind in the two nigger head steam pipe joints by hand and because of the close quarters it was very slow and hard work.

By the use of the device shown the two rings are ground at the same time by the operator, who sits down and pulls the lever back and forth. The two rings are held to the star-shaped piece by four setscrews, the "star" being squared through the center to fit loosely on a square arbor, which arbor is threaded at both ends to receive nuts. These nuts govern the tension on coil



Jig for Grinding in Nigger Head Rings.



Details of Nigger Head Jig.

springs. which hold the rings tightly in the nigger head during the grinding operation.

The lever is squared at both ends and is placed on one square end of the arbor, being sprung apart sufficiently to go over the other squared end. When once in place for grinding it is not removed until the job is completed. All that is necessary is to apply the oil and emery, which is done by pulling the ring back by hand against the tension spring.

Interchange of Ideas

The railroad business has got to that stage where there should be very little if any drawbacks as to fitting comparisons between different lines, as to various operations in their shops, storehouses, and any other practices having to do with materials. Many times at our conventions, the committees have complained of not being able to find out what the other fellow is doing. There should be no secrecy of this kind under present day railroading, because no matter how crude our methods may be, there is always a reason for it, and such reasons are worthy of consideration, and they receive the consideration that they merit in nearly every instance.

The thin-skinned method of railroading is a thing of the past, and personality is left out of such considerations. Why should not any competent railroad official be at liberty to tell a co-worker in a corresponding position of his methods and practices, with a view of betterment in either case? One may have a method of doing certain work that he may be proud of, but why should he not be liberal enough to let the other fellow start along the same lines, or at least give him an opportunity to pick his method to pieces? We are the stronger for such criticism, and no matter how clear an individual may feel he is on a certain subject, there may be others competent to see a little further ahead, or a slight improvement, which if pointed out would broaden the original, make him a better man and advance his practices.

Let us be liberal in our giving out of information for comparison's sake, as it is thought that we withhold many times through fear of criticism by our superior officers. In many cases this is found to be anticipated, and no such criticism would be forthcoming. If we have any special reason for feeling there would be any criticism, then the thing to do would be to lay before such superior, the actual conditions, he will soon set at rest or decide for us, whether such information should be given out or not. Then the question is settled.

A great many having things of this kind in mind have never run it down to see if they could give out this information or not. Do and help others while doing it.—*The Railway Storekeeper.*

DIES FOR DRAWING OUT STOCK

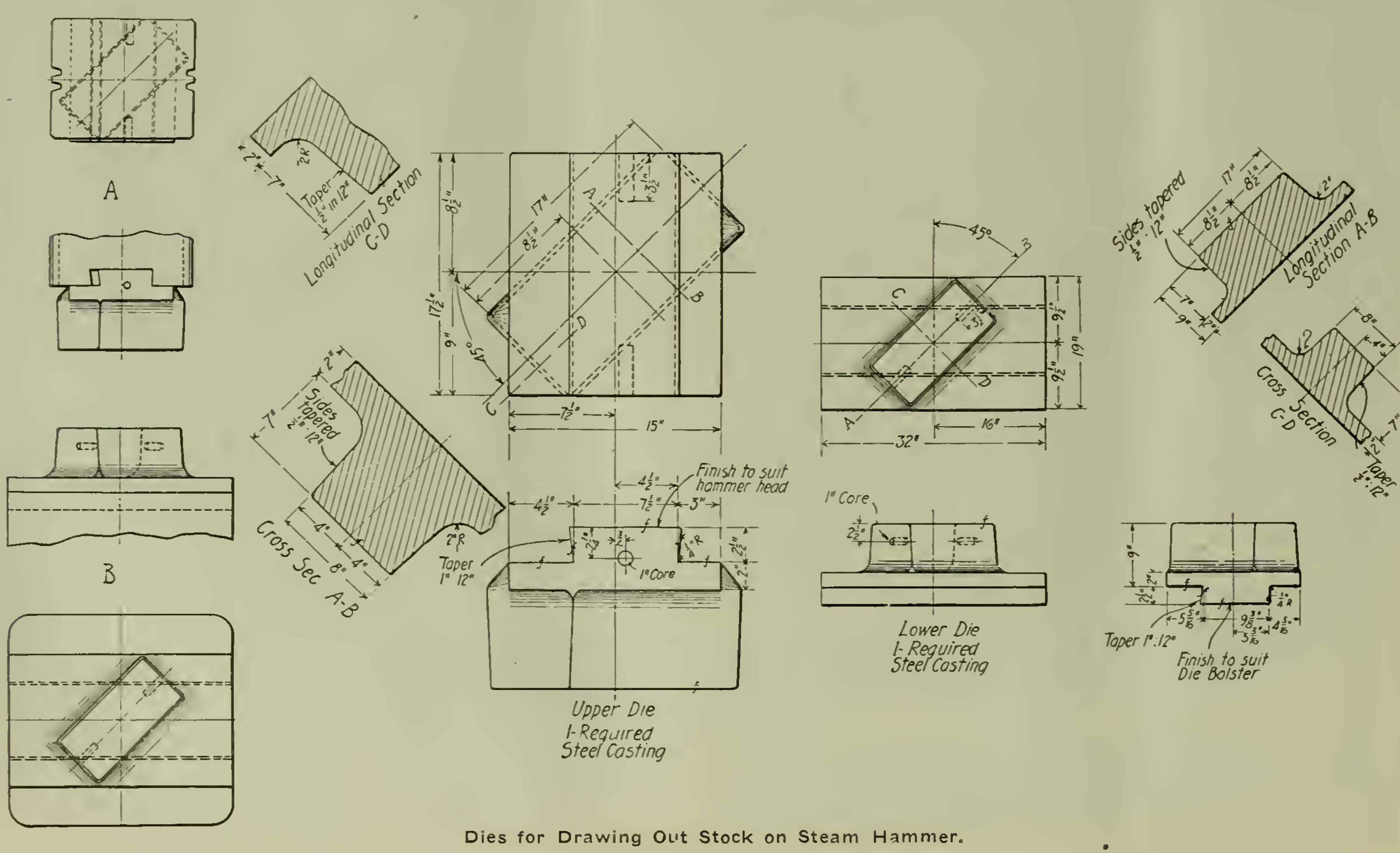
By W. H. Wolfgang.

In the illustration is shown dies made of steel casting for drawing out stock from large to smaller sizes on steam hammers. The dies were designed with the center line of faces at an angle of 45 degrees, so long bars could easily be forged especially in cases where a small space was behind the hammer and also gave a greater working area on the surface of the dies.

One inch holes were drilled in the end of the dies as shown to facilitate in the placing or removing the dies from the hammer and a 7/8-inch steel pin was inserted in the holes. A crane chain sling with either a hook or ring is placed over the pin and it is easily handled with a crane. Also no chain will be in the way so as to allow the dies readily to be placed in the ways and the keyed.

New Service to Coast

The first solid through train ever operated between St. Louis and the Pacific Coast has been placed in service and is composed entirely of all-steel cars. It runs over the Missouri Pacific from St. Louis to Pueblo, Colo., from Pueblo to Salt Lake City, Utah, over the Denver and Rio Grande and from Salt Lake City to San Francisco over the Western Pacific.



Dies for Drawing Out Stock on Steam Hammer.

Factors in the Heat Treatment of Steel

Practical Points in the Handling of Tool Steel, with an Example of Furnace Design at Beech Grove Shops

By Paul H. Cain, C., C., C. & St. L. R. R., Beech Grove, Ind.

Carbon is one of the most important of the elements. It occurs pure in the diamond, and nearly pure as graphite or plumbago. It is a constitutent of all animal and vegetables tissues and of coal, and it also enters into the composition of many minerals, such as chalk and dolomite.

Wood, charcoal, coke and animal charcoal are more or less impure. It is this form of carbon in combination with iron that makes steel. The greater the percentage of carbon the harder and the more brittle the material, such as cast iron, which contains about .350 of one per cent in a graphic state, while tool steel ranges from .50 to .150 of one per cent combined carbon. The ordinary steel we are working contains .08 to .40 combined carbon. It is the carbon that causes the steel to burn so easily in the fire, and the carbon that causes the steel to harden when cooled in water above a certain temperature, which temperature depends upon the percentage of carbon.

Wrought iron which contains very little or no carbon will not burn so easily and will not harden. It is some other element than that which gives iron hardening qualities. Why do we purchase raw bone animal carbon or carbonizing compounds in which to case harden links, pins, bushings, etc.? The various methods of carbonizing are similar to the older method of making carbon tool steel by piling a bar of iron in a furnace, with a layer of charcoal between each bar, sealing the material or furnace so as to prevent the carbon gases from escaping and heating to a fairly high temperature for 36 to 48 hours. While in this heated state the charcoal gives off carbon gases which the heated iron absorbs slowly; the iron and carbon by combining furnish a layer of steel on the bars, just as you are making a layer of steel on iron links, pins, bushings, etc., by case hardening or carbonizing.

Our practical experience gives us confidence and proficiency in our line of work. If we have kept in touch with the various improved materials, and appliances and use them to the best of our ability, then our experience can be considered of value, not alone to us, but to the railroad company we are connected with.

At this period of our existence, we must keep in touch with the progressive methods and apply them and recommend that which is necessary to the increased efficiency of machinery and material.

The temperature desired for forging carbon steel is from 1300° to 1500° Fahrenheit, as it makes the metal softer and easier to work. Forging below 1100° has a tendency to create hammer strains. The grain or structure of the forging will depend upon the temperature when finished. The efficiency of the material depends largely upon the manner in which it is reduced. It is not an unusual custom for a blacksmith when forging square sections, octagons, and rounds, if by testing with the calipers he finds they are considerably too large to rotate them between flat dies until they are reduced in size. If a light blow is exercised, he draws the outer metal, drawing it away from the center portion, causing severe strains between the outer and inner core. This I would term piping the metal. In order to get the efficiency of the material it should be forged uniformly and at the proper temperature. When the tool is forged it should be annealed, not only to soften for the desired machine work, but to relieve the tool of all hammer strains, and all crystallizations due to the high temperature which may have escaped the ripening process during forging.

HARDENING AND TEMPERING.

Distortion of tools by bending or warping can be attributed to several causes. Improper heating, that is, some portion of the tool being heated faster than other portions, causes distortion by upsetting of the part which received the most heat. A tool may be improperly supported or suspended in the furnace or fire, causing the tool to lag, or bend when its critical temperature is reached.

Distortion can also be attributed to unequal cooling, for, if one side or edge of a tool is cooled faster than another, the side that is cold will upset the opposite side. Iron and steel will expand about ⅛" to the foot if heated to a red heat. In cooling one-half of the cross-section it will return to its normal length, and while contracting the compression is so great it will upset the heated portion in proportion to the amount of compression over the resistance of the heated portion. This is a very simple reason for shear blades bending edgewise when you cool the cutting edge in the water to harden, leaving the back portion of the blade hot so you can draw the temper for the desired hardness for the cutting edge.

Tools should be immersed all over in such a manner that the edges and sides will cool at the same time, dipping them perpendicularly with no agitation for the permanent set and then drawing the temper. This will reduce all unnecessary hardness and brittleness. The unequal heating and cooling of reamers, drills, taps, causes them to distort at the shank. Soft spots in hardened tool steel do not concern the toolsmith, as this phase of the subject belongs to the metallurgist or chemist. Nevertheless I feel that they are probably due to a bad mixture when it was poured, with some of its impurities segregating into spots, which only elongate in the hammering and forging. Heavy oxide scales on the surface will prevent the water coming in contact with the steel, thus leaving soft spots.

PYROMETER TREATMENT.

To be successful in treating tool steels with the use of a pyrometer, we must work along fixed principles.

First—The instrument should be supported free from vibration, and a sufficient distance from the furnace to maintain the temperature of the room.

Second—The thermo-couples should be tested with some standard to see if they read correctly. Often you will find that they do not. A very simple method of calibration is by checking with melting of pure salt, which melts at 1474 degrees Fahrenheit. Accuracy can be obtained by using common table salt, the salt being melted in a clean crucible of iron, either in the forge fire, or furnace. Continue to heat it until a temperature of between 1500 and 1650 degrees Fahrenheit is reached. The crucible should be clean because a small amount of foreign substance might raise or lower the melting point. The thermo-couple should be removed from its protecting tube, and the "hot" end immersed in the molten salt. When this has reached the temperature of the bath remove the crucible from its source of heat and allow to cool or freeze, and while cooling the reading can be taken every few seconds on the indicating instrument. By using

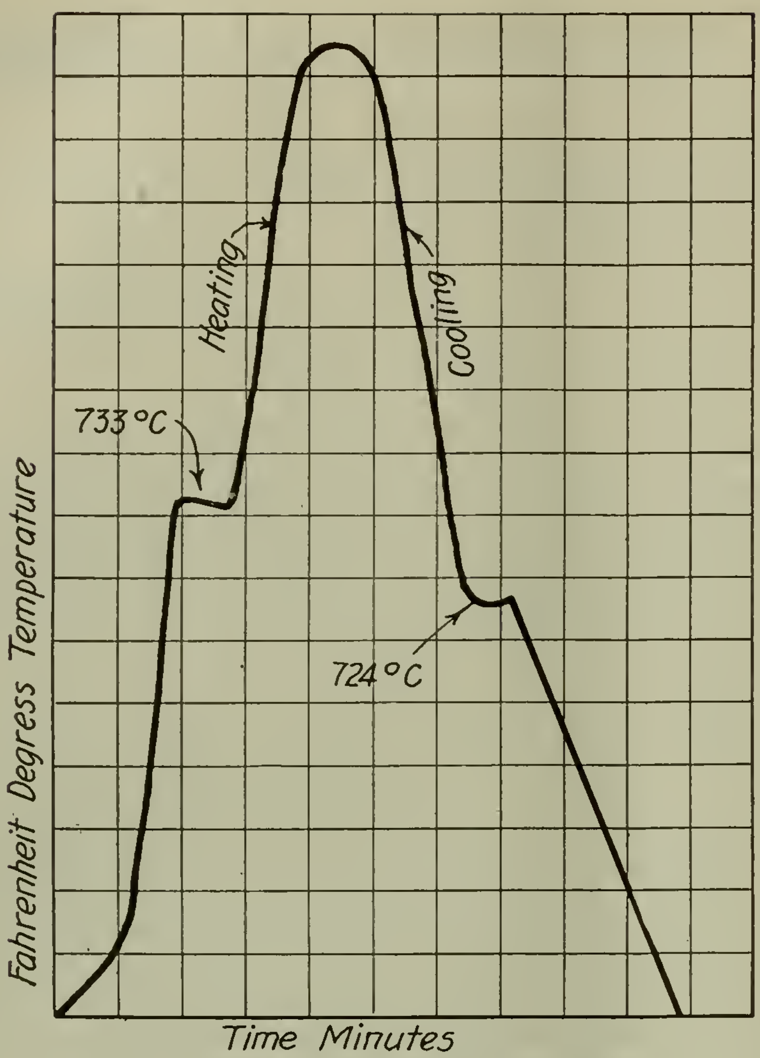


Fig. 1—Curve Showing Critical Points.

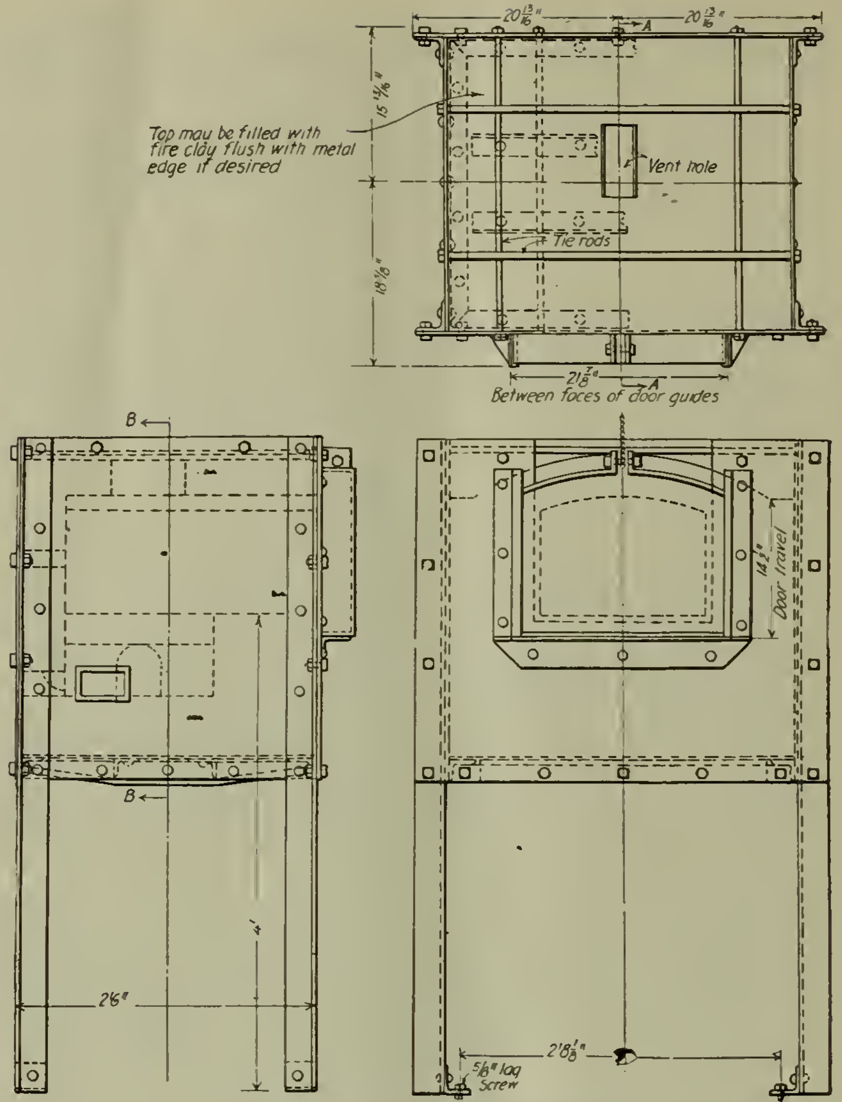


Fig. 2—Oil Heating Furnace at Beech Grove Shops.

time and temperature, a curve is plotted and the temperatures of the melting point of salt, as indicated by the thermo-couple, is noted at the point where the temperature of the bath remains temporarily constant while the salt is freezing. The temperature and the length of time depends on the size of the bath, and the rate of cooling, and it is not a factor of calibration. By reheating the crucible the salt will first begin to melt around the edges, but will take some time to melt around the thermo-couples. Just as soon as the hot end of the thermo-couples gives way from the frozen salt check the instrument and if indicating 1474 degrees Fahrenheit you can feel sure the calibration is correct. When heating a large tool or a piece of steel in a furnace, the "hot" end of the thermocouples indicates the temperature, but must be given time so the heat may soak and become uniform throughout the furnace and metal.

CRITICAL POINTS.

Everyone interested in the hardening of steel probably has noticed the increasing frequency with which reference is made to the decalescence and recalescence points of steel, in articles appearing in technical journals. It has only been during the last four years that this peculiarity of steel has come to the front. The crude, rudimentary and obscure references in the treatises on hardening are of little value to the man in the hardening plant. The curve will illustrate clearly the "critical points" or the decalescence and recalescence.

Fig. 1 shows a curve which can be taken on a recording pyrometer. From this it can be seen that the absorption of heat occurred at the point 733° C. on the rising temperature, and the evolution of heat at point 724° C. on the falling temperature. Unless sufficient temperature is produced when the first action is reached, so that the pearlite carbon will be changed to hardening carbon, and if it is not cooled with sufficient rapidity to eliminate the second action, no hardening will take place. Steel containing hardening carbon heated above the temperature of decalescence becomes non-magnetic. Anyone can demonstrate this by heating a piece of steel to a bright cherry red, and testing it with an ordinary magnet. While at a bright

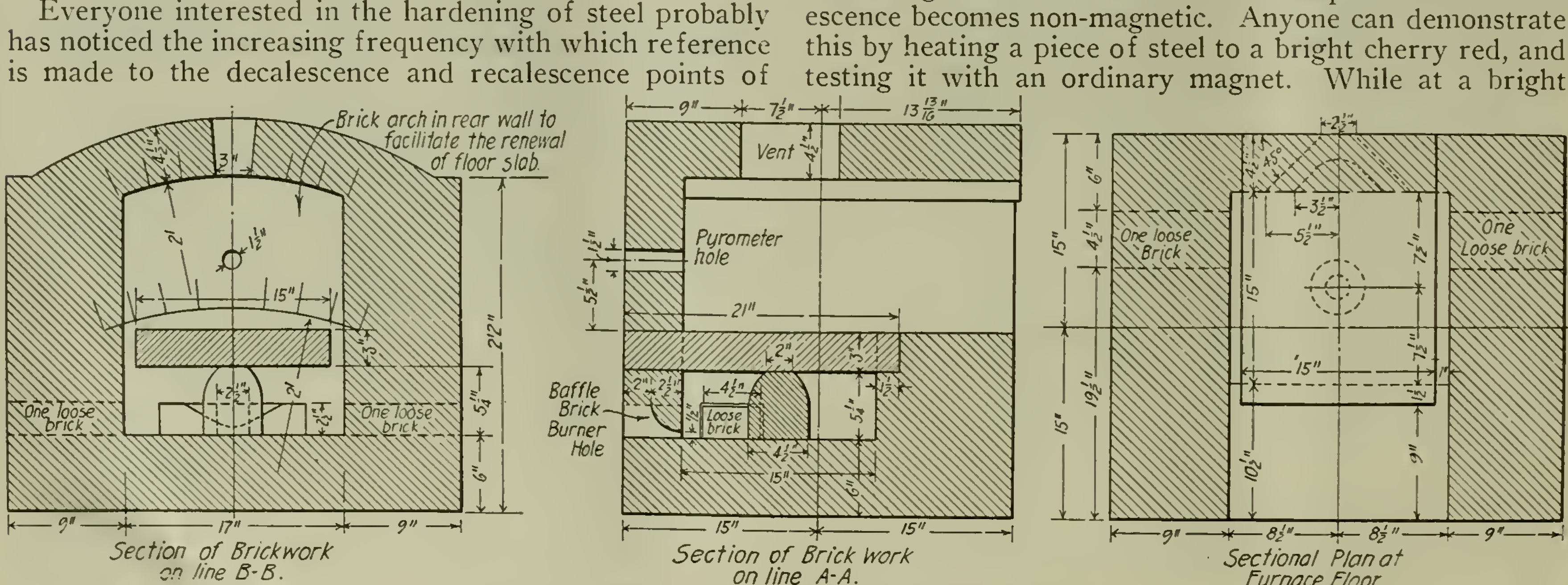


Fig. 3—Sections of Oil Furnace at Beech Grove Shops.

cherry red you will find it will have no attraction for the magnet, but at about a dark cherry red it regains its magnetic attraction. This can be recommended where no installation of pyrometers exists; the only point is to exercise judgment in the length of time a tool or piece of steel should remain in the furnace. After it has become non-magnetic, this time can be varied with the cooling surface and according to weight and size, leaving very little to personal judgment, but it will not be relied upon to destroy granulation or crystallization of carbon steel. I would recommend a special electric furnace for the treatment of carbon and high speed steels. Electricity offers greater advantages. The electric resistance furnace, as built in various sizes, has a superiority over coal, coke, gas or oil-heated furnaces. The temperature of the electric furnace can be accurately and easily regulated and held uniform at any point. The superior quality of work performed by this kind of equipment more than pays for the seemingly higher cost of operation.

At the Beach Grove shops, one of the largest railroad shops in the Central West, H. D. Wright, general foreman of the forge department, has installed an oil-heating furnace, from which we are getting efficiency and production with the use of a pyrometer. It can be regulated and maintained uniformly at any desired point or temperature. Fig. 2 shows the construction of the furnace. A device or counterbalance is used for opening and closing the furnace door. Fig. 3 shows a section of the brick work and combustion chamber.

The British Thermal Unit

One B.t.u. is the quantity of heat required to raise the temperature of one pound of water one degree. As a gallon of water weighs 8⅓ pounds, it requires 8⅓ B. t u. to raise the temperature of one gallon one degree, or 16⅔ B. t. u. to raise the temperature two degrees, and so on.

Thus, when a given coal is said to have a heat value of 13,800 B. t. u. per lb., it is meant that if all the heat caused by the complete combustion of one pound of that coal could be transmitted to 13,800 pounds of water it would raise the temperature of that water one degree. Or, if all the heat could be transmitted to, say, 138 pounds of water, it would raise the temperature of that water just 100 degrees, because

$$138 \times 100 = 13{,}800.$$

The pound of water heated multiplied by the number of degrees the temperature has been raised equals the number of B. t. u. The standard method of finding the heat value of a fuel is to burn a small sample of it in a tight steel bomb under water. The heat caused by the burning of the sample is then all absorbed by the water and by multiplying the weight of the water by its rise in temperature and dividing by the weight of the sample, the heat value of the coal is calculated direct in B. t. u. per pound. Thus, if we burned a small sample weighing one five-hundredth of a pound in a bomb immersed in 5 lbs. of water, and if the temperature of that water increased from, say, 70.4 degrees to 75.92 degrees, a rise of 5.52 degrees, the heat value of the coal would be

$$\frac{5 \times 5.52}{0.002} = 13{,}800 \text{ B. t. u. per lb.}$$

—*The Valve World.*

Mazda Lamps with Concentrated Filaments

The distinctive features of the concentrated filament Mazda lamps of high wattages have proved so popular that the Edison Lamp Works of the General Electric Company has developed vacuum Mazda lamps of similar appearance in the 25, 40 and 60 watt sizes. This concentrated filament construction gives greater vertical distribution of light than the regular Mazda lamps.

Changing Conditions of Train Operation

Extracts from a Booklet of the Bureau of Railway Economics, Together with Interesting Figures on the Cost of Railway Legislation

Until within a comparatively recent time trains were ordinarily made up at the point of origin by the same employees who subsequently handled them on the road. The trainmen switched the cars into place, coupled them, and did all the work necessary to prepare the train for its run, including the inspection of its condition before starting. Cars were coupled to each other and to the engine by the link and pin couplers. Brakemen had to carry links and pins to supply couplers lacking them, and to carry those unused back to the caboose or engine. Coupling was effected by hand, for which purpose the employees had to go between the cars. Trains were controlled entirely by hand-brakes, which had to be worked from the tops of freight cars and from the platforms of passenger cars. Practically all trains rendered local as well as through service—that is, they not only carried through traffic between large terminals, but also stopped at stations along the line to put off and take on goods or passengers. When a car was taken out of a train or taken into a train at one of these local stations, it was necessary to use the hand-brake in the switching needed to make the requisite changes. The work of trainmen at that time was hard and hazardous. The number of cars in a train was considerable. More than thirty years ago, before the introduction of air-brakes, it was the custom of many railways to handle regularly freight trains of forty cars or more with two brakemen. That is, the crew of a freight train, aside from employees on the engine, usually consisted of a conductor and two brakemen. The labor of controlling the train exposed the brakemen to all kinds of weather and involved strenuous physical exertion, for the application of hand-brakes sufficient to hold a train often required both strength and quickness of action. The brakemen had to spend most of their time on the tops of the cars, which in winter were often slippery with ice. Going between cars to couple by hand necessarily involved danger, so that accidents to trainmen were numerous. Passenger cars were heated by wood and coal stoves, which it was the brakemen's duty to take care of.

In 1868 the first successful application of air-brakes to passenger trains was made. In July, 1886, and in May, 1887, the Master Car Builders' Association held a series of competitive trials, with the result that the air-brake was found to be as adaptable to freight trains as to passenger trains. Its use in freight service was thereafter rapidly extended.

In 1887 the Master Car Builders' Association, after several years of investigation, recommended a standard type of automatic coupler. In 1890 the type that had become known as the "Master Car Builders' Freight Coupler" was recognized as standard by the railroad companies of the United States through their official organization, the American Railway Association. In order, however, to compel the adoption of a standard type of coupler by all of the railways of the United States, federal legislation was enacted. In 1893 the Railway Safety Appliance Act was adopted. This law provided that after January 1, 1898, it should be unlawful for any common carrier to use in interstate commerce any car "not equipped with couplers coupling automatically by impact, and which can be uncoupled without the necessity of men going between the ends of the cars." It also provided that it should be unlawful for any carrier to use in interstate commerce any locomotive "not

equipped with the power driving wheel brake, and appliances for operating the train-brake system, or to run any train in such traffic after said date that has not a sufficient number of cars in it so equipped with power or train brakes that the engineer on the locomotive drawing such train can control its speed without requiring brakemen to use the common hand-brake for that purpose." The law was amended in 1903 to provide that at least 50 per cent of the cars in a train should be controlled by air-brakes applied from the engine, and the Interstate Commerce Commission was authorized from time to time, after full hearing, to "increase the minimum percentage of cars in any train required to be operated with power or train brakes which must have train brakes used and operated as aforesaid." The commission subsequently increased to 75 per cent the proportion of cars in a train on which power brakes must be operative, and on September 1, 1910, raised this minimum to 85 per cent.

In consequence of these requirements, the use of automatic couplers and train brakes has become practically universal in the United States. For the fiscal year ending June 30, 1912, 99.05 per cent of the locomotives and cars were fitted with train brakes and 99.67 per cent with automatic couplers. Today it is exceptional for a train to have any cars that are not equipped with air brakes.

These improvements in equipment have had a far-reaching effect upon the work of railway trainmen. The engineer of a train, whether passenger or freight, is now its real brakeman and, save under exceptional conditions, sets and releases the brakes from his cab on the engine. The "brakemen," so called, seldom have anything to do with the brakes except on detached cars during switching operations. Indeed, the term "brakeman" is now a misnomer and is being displaced in railway usage by the term "trainman." The general substitution of the automatic coupler for the old link and pin has changed the character of the trainman's work in coupling and uncoupling and has very greatly diminished the hazard. Indeed, railway managers claim that, if the trainmen comply with their instructions, the hazard is eliminated entirely. Formerly, when coupling cars, the brakeman had to stand between the cars at the moment of their coming together in order to guide the link into its place. This entailed great risk of having his hand crushed, as well as of being thrown down and run over. Now, any necessary adjustment of the coupler can be made, and ought to be made, before the cars are put in motion to effect the coupling. Formerly, when uncoupling, the brakeman had to stand between the cars to remove the pin. Now, the pin that locks the coupling can be removed by a rod extending to the side of the car. Thus during neither the coupling nor the uncoupling does the trainman need to stand between the cars. These changes apply to both freight and passenger cars. How greatly they have reduced the hazard of coupling and uncoupling cars is indicated by the following table:

Casualities to Trainmen from Coupling Accidents 1890 and 1913.

Year.	Total number of trainmen.	Total killed.	Total injured.	Number killed for each 10,000 trainmen.	Number injured for each 10,000 trainmen.
1890	153,235	265	6,073	17	396
1913	339,600	184	3,293	5	97

In addition to the changes in their work directly resulting from the introduction of air-brakes and automatic couplers, there have been other modifications in the duties of trainmen which may be briefly noted. In the first place, the train crew as a rule no longer makes up and inspects the train at terminals. Switching crews now make up all trains at all important points of origin and, after they have been inspected by inspectors employed for that purpose, deliver them to the train crew ready for operation. The train crew has no more to do with the preparation for the run than to test the brakes. At the end of the run the train crew has only to deliver a train to the switching crews, which separate the cars for further disposition. It may also be noted that the work and responsibility of freight conductors en route has been lightened by the present practice whereunder a yard clerk furnishes them a statement of the cars in the train, with the respective destinations, from which the conductors check off each car as it is set out and to which they add other cars as they are picked up. Formerly, the conductors had to prepare these statements of the cars composing the trains.

Again, the trainman's duties on passenger trains are less arduous because passenger trains are now almost universally heated with steam or hot water from the engine, and the trainman has only to regulate the degree of heat. The gradual displacement of the oil lamp by gas and electric lighting has relieved the trainman of many former duties.

Increase in Trainloads

Coincident with the development of safety appliances on trains, there has been a steady and rapid increase in the length and load, particularly of freight trains. Generally speaking, transportation is conducted most economically when traffic is handled in the largest units. The larger the loads per car and per train, the less the relative investment that must be made in roadway, track and equipment, and the less the relative expenditures that must be made for maintenance of way and equipment, and for conducting transportation.

Faced with steadily increasing expenditures for wages, materials and taxes, with revenues from the transportation of freight and passengers not increasing at nearly the same rate as expenses, the railways have found it necessary to practice economies in operation. The greatest economies have been secured by increasing the number of tons hauled per train, and by increasing the amount of traffic handled in proportion to the number of men employed. The extent to which, in their efforts to handle traffic economically, the railways of the United States have increased their trainloads is indicated by the fact that the average number of tons per train in this country in 1890 was 175; in 1900, 271, and in 1912, 407. In the region of heaviest traffic, that comprising in general the States of New York, Pennsylvania, New Jersey, Delaware and Maryland, the average number of tons per train increased from 218 in 1890 to 502 in 1910. On some lines the average trainload exceeds 1,100 tons; trainloads of minerals ranging from 3,000 to 5,000 tons are not uncommon, and sometimes a train has as many as 6,000 tons. These heavy increases in trainloads have been effected very largely by increasing the capacity of cars and their loading, and by increasing the number of cars in a train. The average capacity of a freight car in this country increased from 28 tons in 1902 to 37 tons in 1912. Loaded freight trains often contain 50 to 75 cars, and trains containing even larger numbers of empty cars and exceeding a half mile in length are run not infrequently in some parts of the country.

There has been no such corresponding increase in the length of passenger trains, although passenger trains on main lines are somewhat longer than they were in past years. Often 12 to 16 and even more cars are pulled by a single engine; the passenger cars have increased in size and especially in weight.

With this increase in car loading and train loading there has been a decrease in the number of men required to handle a given amount of traffic. It has not, however,

been accompanied by a decrease in the total number of trainmen, for, as is shown later, their number increased from 1901 to 1912 at a greater rate than the car mileage or the train mileage.

INCREASE IN OPERATING EXPENSES

It is obvious that an increase in the number of men in a train crew means an increase in the operating expenses and, unless accompanied by a corresponding increase in the traffic per train or in rates, means a decrease in net operating revenues. The railways are reporting to the special committee on relations of railway operation to legislation careful estimates of the additional expense resulting from operating legislation already enacted. On January 26, 1915, the committee made public the following compilation of replies received by it from 166 railways, operating 204,610 miles of line, regarding the expense caused them in the fiscal year ended June 30, 1914, by legislation, both Federal and State, affecting operation:

COST OF LEGISLATION AFFECTING RAILWAY OPERATION—SUMMARY OF REPLIES OF 166 RAILWAYS, OPERATING 204,610 MILES.

FEDERAL AND STATE LAWS.	Cost of Compliance. Year ending June 30, 1914.	Total to June 30, 1914.	Amount necessary to complete (estimated).
Hours of service	$ 5,013,345	....	....
Full (extra) crew	4,051,533	....	....
Boiler inspection	4,141,051	....	....
28-hour stock law	247,119	....	....
Semi-monthly pay-day	826,586	....	....
Safety appliance	5,965,926	$23,845,436	$19,588,408
Postal car requirements	890,907	4,391,531	3,129,670
Ash pan	86,818	2,017.562	165,073
Headlight	1,002,840	2,635,294	624,966
Caboose	597,206	949,029	2,614,406
Jim Crow	29,623	659,380	1,468
Other enactments	2,785,850	12,852,649	96,684,127
Specific orders, State Commissions	3,065,179	....	....
Total	$28,703,983	$47,350,881	$122.808,118

	Number Persons Killed.	Injured.	Total.	Property Damage.
Collisions where third brakeman was employed, year ending June 30, 1914	30	641	702	$411,228

It will be seen that the total expense caused by operating legislation in the fiscal year 1914 to the railways reporting was $28,703,983. This would pay a return of 5 per cent on an investment of $574,000,000. The total expense caused by the extra-crew laws was $4,051,533. This would pay 5 per cent on an investment of over $80,000,000. This estimate applies to the expense to the railroads on account of train-crew laws enacted in only a limited number of States. The full effect can be seen only from estimates that apply on account of all such laws to all the railways in the United States. Four train-crew bills were introduced in Congress in 1909 and 1910. The special committee on relations of railway operation to legislation made inquiries early in 1910 of all the railways as to the cost to them of complying with these Federal bills, if enacted, as well as the expense they were being put to on account of State legislation then in force in 13 States. The following table is a summary of the replies received:

ESTIMATE OF 1910.	Number.	Mileage.	Amount of additional annual cost of compliance with full-crew bill.
Roads replying	166	205,547	$18,328,302.32
Estimated for other roads exclusive of Canadian and Mexican roads	126	23,254	1,953,336.00
Total	292	228,801	$20,281,638.32

Another bill was introduced in Congress in 1912 which required that on each freight train containing 25 or more cars the crew should consist of at least an engineer, a fireman, a conductor and three brakemen, "regardless of any modern equipment of automatic couplers and air-brakes." This bill made no reference to passenger-train crews. As a result of inquiries made of the railways by the special committee on relations of railway operation to legislation, in connection with this proposed Federal law, the following compilation was made from the replies received from 143 operating companies:

ESTIMATE OF COST, IN 1912, OF TRAIN-CREW LAWS FURNISHED BY 143 OPERATING COMPANIES OPERATING 195,049 MILES.

Trains affected by State laws then in effect, per annum	678,661 *a*
Additional trains affected by proposed Federal law in States then having full-crew law, per annum	468,483
Trains affected by proposed law in States then having no full-crew law, per annum	3,211,056
Total trains affected by State laws and proposed Federal statute, per annum	4,358,200
Cost of compliance with State laws then in effect, per annum	$ 1,797,589.94 *a*
Additional cost of compliance with proposed law in States then having full-crew law, per annum	1,342,237.17
Cost of compliance with proposed law in States then having no full-crew law, per annum	10,255,790.66
Total cost per annum of compliance with State laws and proposed statute	$13,395,617.77

a Does not include States where laws were passed subsequent to 1911.

It should not be overlooked that this expense is only a part of the total increase in operating expenses that has been caused by legislative requirements imposed upon railroad operation. Such further legislation includes laws requiring 8-wheel cabooses in place of 4-wheel cabooses, laws limiting the hours of service, requiring electric headlights, requiring the installation of improved safety appliances, regulating the stops of passenger trains, the speed of stock and freight trains, requiring the abolition of grade crossings, or the installation of additional watchmen at crossings, requiring double track, and providing for days off at the company's expense. Quite independent of the question of the defensibility of these laws is the fact that they add greatly to the expense of railway operation, which must eventually find expression in higher charges to the public than would otherwise be made.

However, the fact that such train-crew legislation increases operating expenses is not a conclusive argument against it. The legislation, presumably, is intended to promote the interest of the public, and the question at issue is whether there are benefits directly or indirectly conferred on the public, and, if so, are they commensurate with the expense incurred.

Hand Firing Soft Coal

"Hand Firing Soft Coal Under Power-Plant Boilers" is the title of Technical Paper 80, just issued by the United States Bureau of Mines, as an aid to the firemen employed in manufacturing establishments throughout the United States.

The paper, which contains descriptions of methods of firing soft coal under power-plant boilers and of methods of handling fire so as to have the least smoke and to get the most heat from the fuel, seeks to meet the needs of the men, many without a technical education, who are employed in small plants of 1,000 to 2,000 horsepower capacity. For this reason the language used is plain and simple, and technical terms have been avoided as far as possible.

Copies of this paper may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

Electric Locomotive Exhibit

A Large Pennsylvania Locomotive Will Be Mounted on a Turntable in the Transportation Building at the Panama-Pacific Exposition

One of the most striking exhibits to be made at the Panama-Pacific Exposition will undoubtedly be that of the Westinghouse Electric & Manufacturing Company, which includes one of the Pennsylvania Railroad locomotives mounted on a turn table.

The location of the turn table is under the center of the dome of the immense Transportation Building at the junction of the two main aisles, thus bringing it in full view of crowds which are expected to pass through this building, which will contain a large number of exhibits of great interest to the public at large.

Some idea of the vast size of the building may be gathered from an authentic story told of an erecting engineer who endeavored to locate the center of the building with his eye by standing under the dome, which seemingly was an easy task. When accurate measurements were afterwards made to verify this it was found the point previously selected was 12 feet off from the actual center.

The turn table is 65 feet long, and weighs 440,000 pounds, including the locomotive. The height of the track is 12 feet above the floor, and steel ties are used, a new type of construction for this class of work.

By means of 10 horsepower, 3-phase, 220-volt motor the turn table is caused to revolve at a speed of once in three minutes, thus giving the crowds in each end of the building different views of the locomotive. The rotation, which can be reversed in direction, is under the control of the operator located in a booth nearby.

A decidedly unique method of collecting the current for lighting the locomotive is employed. This was designed by the Westinghouse engineers and involves bringing the leads up through center bearing, to collector rings, thus obviating the use of third rail shoes or trolleys.

The locomotive is arranged and lighted so as to permit the people to pass through it and inspect the equipment. It is clamped to the turn table by means of steel bands so as to prevent any possibility of its becoming dislodged in the event of an earthquake.

This locomotive is said to be the largest in the world in passenger service. It consists of two units and weighs 156 tons, and is the first side-rod gearless locomotive ever placed in service.

It is equipped with two motors having a total capacity of 4,000 horsepower, and Westinghouse unit switch control equipment of the HBF type, which has made the phenomenal record of 99,549 miles per train minute delay power control failure. Twelve million passengers annually are transported over the electrified terminal of the Pennsylvania Railroad from Harrison, N. J., to Pennsylvania Station, New York City, by these locomotives, which are capable of attaining a speed of 60 miles per hour with full train.

RACK FOR RAILWAY STOREROOMS

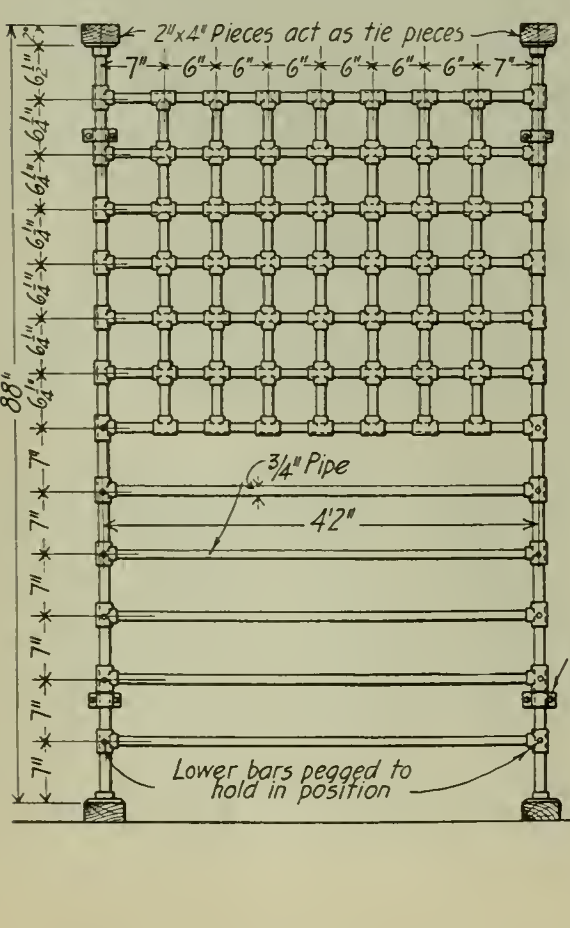
By W. T. Walters, Memphis, Tenn.

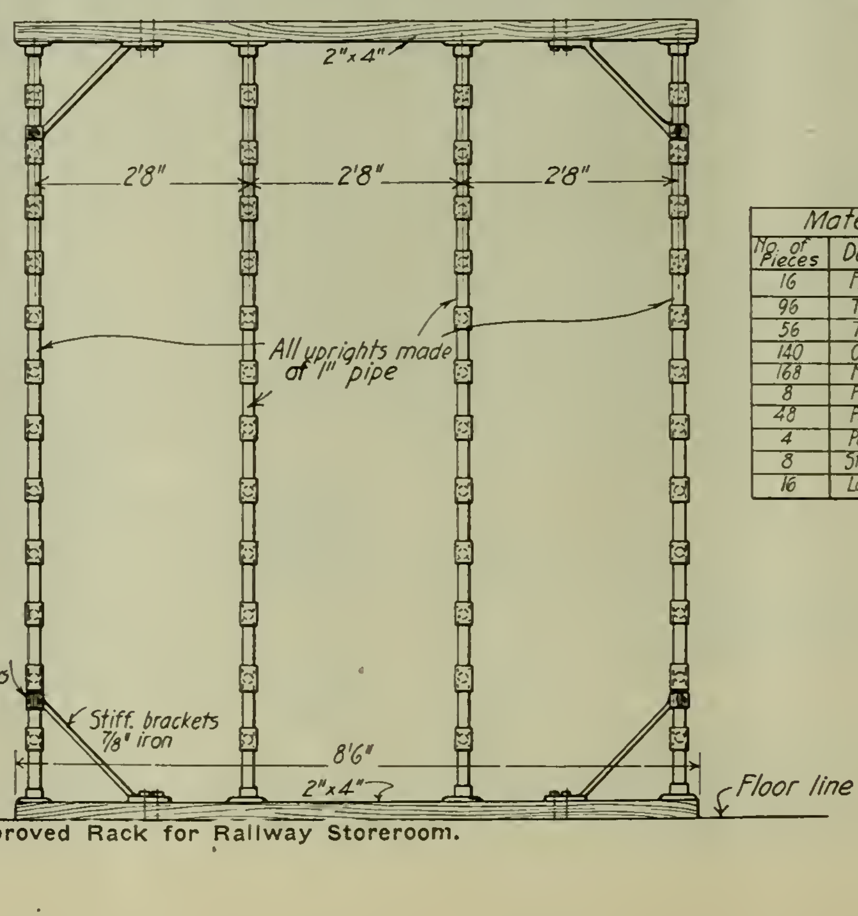
This rack was designed from ideas set forth by L. L. King, division storekeeper of the Illinois Central at Memphis, Tenn. At a large storeroom in railway shops it is necessary to keep on hand a stock of high-priced steel for tools, etc., also copper, rod and pipe. As this rack was to be installed in a fireproof building, it was necessary to keep it as fireproof as possible in order to conform with the building. Hence, the design of this rack.

It was built of three-quarter-inch pipe and fittings with one-inch pipe as standard. The only part not of a fireproof nature are the 2″x4″ strips which serve to tie it together.

The total cost of material for this rack amounts to $20.60 and the labor charge, which involves reaming out tees and crosses, cutting of nipples, threading of pipe and erection, is $19.31, making a total charge of $39.91, which is exceedingly reasonable when one considers that a rack of this nature is practically indestructible and will outwear three or four racks of a similar nature made of wood. The upper half of rack holds the lengths of tool steel, copper pipe, etc., while in the lower half sheet copper and high-priced sheet metal is stored. This rack has been the subject of many favorable comments by various railway officials who have seen it.

THE GRAND TRUNK and Grand Trunk Pacific Railways are carrying on their payrolls some six hundred men who have been enlisted for over-seas service with the various military units in the European war.





Material List		
No. of Pieces	Description	Sizes
16	Floor plates	1″
96	Tees	1″x 1″x 3/4″
56	Tees	3/4″
140	Crosses	3/4″
168	Nipples	5″x 3/4″
8	Pcs 1″ pipe	7′1″ long
48	Pcs 3/4″ pipe	4′0½″ long
4	Pcs 2″x4″	8′6″ long
8	Stiff. brkts	7/8″ Iron
16	Lag screws	3/8″ x 2″

Improved Rack for Railway Storeroom.

The Advance of Electrification on Heavy Traction Roads

A Paper Read Before the Western Society of Engineers Containing Observations on the Electric Operation of the N. Y. N. H. & H. R. R.

By W. S. Murray, Consl. Elect. Eng., N. Y. N. H. & H. R. R.

In the early days when electrical movement was first introduced on heavy traction railroads, theory was strong and practice severely limited. The guiding principle upon which electrical men based their opinion that electrification had its proper place in the economic world was that by its use certain savings could be effected that would justify the investment necessary to secure it. There was entirely outside of this, but indirectly an economic factor, the advantage accruing to the passenger in the form of a clean ride.

While I have, of course, been keenly interested in electrification that has been applied to other railroads, naturally the past ten years' association with the New Haven work, during which time over $15,000,000 have been expended in this department of betterment, has brought the real elements of its progress within very close range.

In June, 1914, the first New York, New Haven & Hartford passenger train was operated from Grand Central station to New Haven over a four-track electrified route 73 miles in length. Between New York and New Haven, measured upon a single-track basis, there are some 500 miles of electrified line, of which 184 are included in yards and sidings. On these tracks today, every class of passenger, freight, and switching movement is made and electrical statistics are kept of all power-house, line or equipment failures, a reference to them suggesting the features of electrical operation that require first attention for the betterment of service.

A feature of electrification that at present is the most appealing to one who has given the subject some consideration is in the matter of freight and switching movements. Since 1907 the New Haven road has been operating its regular 100 per cent electric passenger service between Stamford and New York. But recently, experience with regard to electric movement in switching and classification yards, and more recently that with regard to freight movement on main line track, has indeed been a revelation in the possibilities of heavy electrical traction. For example, during the month of January past, on the New Haven over 40,000,000 ton miles trailing load were handled by electric locomotives, this total tonnage being made up of fast, slow and local freight movement. There is installed on all of the electric engines wattmeters to register the kilowatt hours of consumption. Records of these wattmeters indicate that fast freights require on the order of 34 k. w. hours per train mile; slow freights on the order of 60 k. w. hours per train mile, and local freights on the order of 36 k. w. hours per train mile. These figures are for trains varying in tonnage from 1,000 to 3,000 tons.

Of interest also are the kilowatt hours per 1,000 ton miles of trailing load. For fast freight the kilowatt hours per 1,000 ton miles are on the order of 30; for slow freight, 30; and for local freight, 85. I make mention of these figures only to illustrate this new and vast sum of information that is daily coming to us. The "watt hour constants" are of necessity average figures, made up of trains having varying weights and schedules, and yet the records from which they are taken admit of instant segregation into any class of service for which a constant is desired. The question that might be asked in looking at these constants is: What do they signify? and the answer is brief: An electrical ton mile as against a steam ton mile reduces the coal pile in a ratio of 1 to 2.

While in the past we have appreciated the economies to be secured through electrification, in virtue of lesser expenditures required in fuel and maintenance of electric engines as against steam, there is fast coming to the front what might be called a more visualized economy in the reduction of expenses by effective savings in train miles.

Illustrative of the economic value of a "kilowatt hour" in its application to an electrification system, I quote from a part of a recent letter which had reference to the utilization of some 4,500 k. w. of demand in connection with its application to the eastern section of our electrification zone. I would particularly draw your attention to the item of $49,275.00, which has reference to the economies to be gained by the double heading of freight trains operated between Harlem River and New Haven. This economy, and its automatic complement, the increase of track capacity, are the phases of electrification that are striking deep into the consideration of the steam operation railroad man.

"(1) The extension of the station contemplates, as you know, supplying a maximum single-phase demand of approximately 4,500 k. w. This amount of power measured by train units would permit the operation of twelve additional daily trains in fast freight service of average tonnage or its equivalent in any other class of service between Harlem River and New Haven.

"(2) The number of kilowatt hours which would be consumed by the above twelve trains would be 17,500,000 k. w. h. annually, and, as previously discussed with you, upon a coal ratio of 1 to 2 in electric and steam service, and a basis of three lbs. per kilowatt hour and $3.00 per ton, an annual saving to the railroad company of $78,750 is indicated.

"(3) Further translating the above movement into engine miles, our log sheet records indicate that the number of engine miles required for the above movement would be 990, which multiplied by the difference in cost of engine repairs at 5c per engine mile, effects annual savings of $18,250.

"(4) The transfer of twelve daily trains from steam to electric service will permit a further extension of our present practice of "double heading" trains in electric service, thus saving 450 daily train miles, which, as shown by our log sheet, will secure an annual reduction in train wages of 30c per train mile, corresponding to an annual reduction of $49,275.00.

"(5) A supply of approximately 3,000 k. w. (average) to the New Haven end of the line will effect a further saving of $16,500.00 in transmission losses, as compared with the transmission losses of the same amount of power from Cos Cob Station; the above savings being based upon the conservative cost of 5 mills per k. w. h. In explanation of the apparently large value of the saving in transmission losses to be effected by this small installation, it will be evident that its value is maximum when applied at the extreme end of the transmission system.

"(6) No tangible values can be assigned for the very important effect upon the regulation in line voltage at New Haven, which will be reflected in the cost and efficiency of operation in many ways.

"(7) The summary of the total savings as above which will be effected is as follows:

Fuel	$ 78,750.00
Engine repairs	18,250.00
Engine and train wages	49,275.00
Transmission losses	16,500.00
	$162,775.00

If any criticism can be placed with regard to the matter of freight movement by electricity, I would say it would be in the matter of speed. The electric freight locomotives of the New York, New Haven & Hartford were built on specifications that permitted them to operate 1,500-ton trains on level track at 35 miles per hour. While the speed element, in as far as the New Haven service is concerned, may be entirely justified, due to the very large ratio of passenger to its total service, thus permitting the freight trains to clear more promptly for passenger traffic, I would say that where the ratio of passenger service is less, the speed element for equal horse power could be more valuably thrown into traction. For example, the New Haven locomotives have draw-bar pull characteristics that permit the operation of 3,000-ton trains by double-heading. If these engines were reduced in speed by 35 per cent and their traction increased by the same percentage, 4,000 tons would be the resulting double-header trailing load, which in turn would effect a large saving in train miles, were these engines to be operated on a property less subject to passenger movement.

Much valuable information has been developed in the past two years in connection with the handling of classification and switching yards by electric motive power. An idea as to the reliability of this class of service may be gained in saying that in 1,000,000 electric switch engine miles, there has been but one failure.

The New Haven property includes in it two large switching yards; the Oak Point yard containing 35 miles of track and the Harlem River yard 25 miles. The introduction of the electric engine in these yards has increased the speed of the yard very greatly, and as near as I can gather from the yardmasters, this increase of speed has been secured with a ratio of electric engines to steam engines replaced, varying between 4 to 6 and 6 to 10.

I am a firm believer in the single phase system for trunk lines, the governing element in which, from an electrical standpoint, has been the transmission system. In a rigorous determination to adhere to this principle as correct for such a field, it has not been to gainsay the application of direct current in the territory where it rightly belongs; namely, where the governing element has been mass (trains under acceleration and braking in close headway) in translation. As a citation of the two examples, I would offer: (1) The electrification from New York to New Haven, and (2) the electrification of the New York subways.

In closing my address, I would speak of two things which to my mind are most pertinent to the advance and successful utilization of electricity in the field of heavy traction.

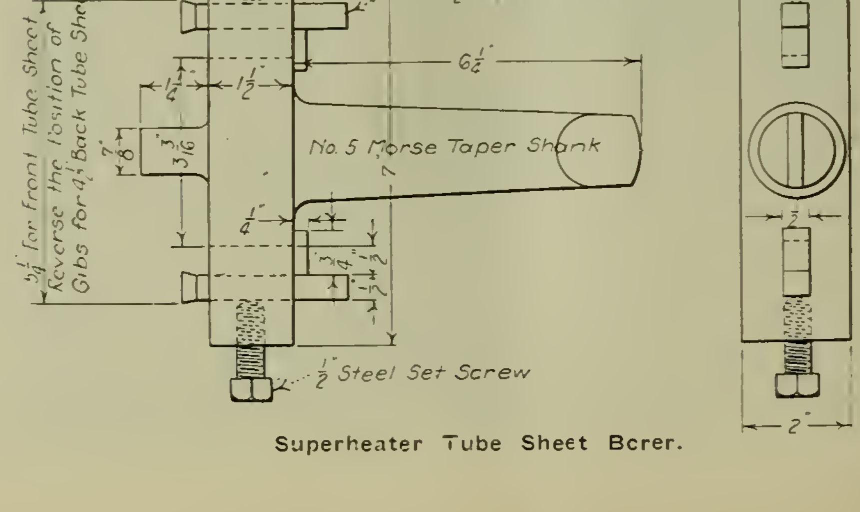
The first is with reference to the mercury arc rectifier, and the second is in regard to effective electrical administration on the part of railroads electrifying.

Having reference to the mercury arc rectifier, there has been in commercial operation on the New Haven road a car taking power from the 11,000-volt alternating current overhead contact system, and converting it into direct current for application to its propulsion motors. This car has been giving a most successful service, and the problem of the production and maintenance of the vacuum tube, through the agency of which the alternating current is converted to direct, has been electrically and commercially solved. What are the possibilities accruing from such a result? This can be epitomized in the statement that if the economies in the transmission system of the single phase system justified the utilization of a heavier and less efficient motive power, today we are in a position not only to secure the economies gained in this transmission, but operate beneath the contact wires of such a system the more efficient and lighter direct current apparatus. As a concrete and practical application of this result, the present alternating current motive power now in use on the New Haven, by the application of the rectifier, will be increased 25 per cent, and also permit it to enjoy simultaneously transmission and motive power facilities of the highest order of efficiency.

With regard to administration, past experience with the engineering, construction and operation of a trunk line property of the character of the New Haven road has indicated with force the necessity of a very complete understanding of the difference between the operation of a steam and an electric property. In my judgment, there will be no necessity for any general change in the administration or organization at present observed in steam operated properties to effect proper electric operation, but upon the minds of higher officials in the steam roads using or contemplating using this new mode of motive power, the fact should be impressed that the methods pursued in producing a ton mile of any character, passenger, freight or switching, upon a steam basis, must be abandoned when the draw-bar pull comes from electricity. The error of holding a steam master mechanic responsible for an electric engine mile of any character is patent, and equally patent is the error of holding a steam railroad shop man responsible for the maintenance and repairs of electric engines. Like electric power houses and transmission lines requiring the proper electrical talent, essentially necessary to the success of proper maintenance and inspection of electric motive power are the electro-mechanics inside and outside of the shop. Such an arrangement does not change, but merely affects the splendid railroad organization and administration that has come down to us. A successful operating result after electrification has been applied is entirely dependent on a clear understanding and observation of this real difference between steam and electrical operation.

SUPERHEATER TUBE SHEET BORER

The accompanying illustration shows a superheater tube sheet borer in use on the Canadian Northern. The tube sheet is laid for all holes and these are centered with $\frac{15}{16}$" holes which form a guide for the ⅞"x1½" tool nose. The cutter illustrated forms a hole ⅛" smaller in diameter than the finished size and this ⅛" is then reamed out, as is the practice with smaller tubes.



Superheater Tube Sheet Borer.

FILES AND FILING

The file is one of the most indispensable tools of the mechanic, and is a product of the highest skill in quality of material, workmanship and tempering. In few other places is steel given so severe a test of its quality as in its use as a file.

Formerly file makers had to forge the steel down to size from the bar, but now steel makers furnish steel in exact sizes for all files in common use, and the file maker needs only to draw down the tang for the handle and taper the point, when necessary, before finishing the surface and cutting the teeth. This shaping is done very rapidly under power hammers in modern shops.

Many files are named from the shape of their cross-section, and are those most generally used, while others are named from the particular work they are intended to be used upon.

The "half-round" is about one-third of a full circle, but the "pit-saw" is a full half circle in section.

The faces of the "three-square" are equal, the angles being 60 degrees each, while the angles of the "cant-saw" are two of 35 degrees and one of 110, and those of the "cant file" are two of 30 and one of 120 degrees.

The "hand" file is the same width from heel to point, but is tapered in thickness from middle to point.

The "mill" file is the same thickness throughout its length, but the width is tapered usually, though it is often made "blunt"—that is, of equal thickness and width throughout.

The "warding" file is the same thickness, but is tapered in width from heel to point.

The "pillar" file is the same width and thickness throughout its length. It is made in standard, narrow and extra narrow patterns, and also with one or two "safe" edges—that is, faces on which no teeth are cut.

The "three-square," "square" and "round" are made in both the "slim" and blunt forms, the "slim" being of regular length, but of smaller cross-section.

After forging to size and shape the blanks are thoroughly annealed in special furnaces, this operation taking from twenty-four to thirty-six hours. After annealing they are straightened and the scale removed by grinding on grindstones. They are then draw-filed until perfectly smooth and even and are then ready for cutting.

With regard to the shape of their teeth files are classified under three heads—"single cut," "double cut" and "rasps." The "single cut" has teeth made by single rows of parallel chisel cuts across the faces, the cuts being made at an angle of from 65 to 85 degrees, according to the size of the file and the kind of work it is intended for.

The "double cut" has two rows of chisel cuts crossing each other. The first row, on files intended for general work, is at an angle of from 40 to 45 degrees, the second being from 70 to 80 degrees, while on the finishing files the first row is at an angle of about 30 degrees and the second at about 85 degrees.

In the "single cut" the tooth extends across the entire face of the file, while the "double cut" is broken up into a great many small teeth inclined toward the point and shaped like the end of a diamond point cold chisel.

The teeth of the "rasp" are entirely separated from each other, and are round on top, being formed by raising small portions of stock from the surface of the blank with a punch. Rasps are used only on the softer materials, such as wood, leather, horse's hoofs and sometimes on babbitt metal.

With regard to coarseness of the teeth there are six grades of cut—"rough," "coarse," "bastard," "second cut," "smooth" and "dead smooth." The "rough" file is nearly always single cut and the "dead smooth" double cut, while the other grades are made in both single and double cut. The coarseness again depends on the length of the file, as a four-inch "coarse" file will have much finer teeth than an eight-inch "coarse" grade.

The value of a file depends on the quality of the material used, the workmanship employed in shaping the teeth and the temper, but the life depends, in addition to these, to the use to which it is put and the care given it.

If all the teeth on a file were of exactly the same height it would require a heavy pressure to make it cut, and it was formerly thought that a machine-cut file would have that characteristic and for that reason would be inferior to a hand-made file. To overcome this machines are now made to give them what is known as the increment cut, in which there is a slight difference in the distance between the cuts. The difference is very slight, however, as there is only about one one-hundredth of an inch difference between the first and last cuts on a 12-inch file. In a hand-cut file, even with the most skillful workman, some variations were bound to occur, and these irregularities were supposed to make the file cut easier.

The work is performed very rapidly on machine-made files, the chisel receiving from 550 to 3,500 blows per minute, according to the size of the file being cut. The cutting is from point to heel, and when one side of the blank is cut it is placed on lead strips to prevent injury to the teeth already formed.

After cutting, files are inspected and assorted, then hardened and tempered, at which time any warping or twisting is corrected, then inspected for temper cracks and tested for hardness on a piece of hard steel. Finally they are coated with oil and wrapped in several layers of paper to prevent rusting and injury when packed for shipping.

In filing a narrow surface or a thin piece of metal it is better to use a single-cut file, as the teeth of a double-cut cut too freely or take too big a bite and are very liable to break. The shape of the single-cut tooth gives it more strength and it is less liable to break.

Files are made "tapered," that is, thinner at the point than at the middle, or "full tapered," thinner at the point and heel than in the middle, for two reasons; first, to permit a fewer number of teeth to come in contact with the work, thus making it cut easier, and, second, to permit the user to file a straight or plane surface. If the file is perfectly straight the motion to produce a true surface must be absolutely parallel to this surface. This the most expert mechanic can scarcely do, the attempt resulting in work low at the edges and high in the middle. If the file is tapered the surface is slightly convex, and if moved entirely across the work a straight surface will result, as the workman can allow some deviation from a straight line in the motion of the file and still not cut away the edges more than the center.

A sharper file is required to file the non-fibrous metals, as brass or cast iron, than for wrought iron or steel, and for a broad surface than for a narrow one. A good mechanic will therefore use his files first on broad surfaces of brass or cast iron, next on narrow surfaces of these metals, then on wrought iron and steel, and finally for removing sand and scale from castings and forgings.

A new file should never be used on rough castings, as the scale is very hard and will ruin a file in a very few minutes. The edge of a flat file, which frequently is not used for other purposes, can be used to advantage for this work.

A file is distorted more or less in hardening, making one side more convex, or having more "belly," as it is usually called, and this side is used on the most particular work by the good mechanic, as he can make it cut just where he wants to.

In filing, the work is all performed on the forward stroke, though the file is not raised during the return stroke, but no pressure is applied at this time. As the file is pushed forward it should be given a slight side motion, alternating after each few strokes to the right and left. This makes the file marks cross at quite an angle and makes it cut freer and keeps the surface more nearly true.

The handle of the file should be seated against the palm of the right hand and the thumb extended along the top. The point should be held by the ball of the left thumb on top of the file, and the fingers underneath. By placing the thumb as far as possible, conveniently, from the end, the file, if a flat one, may be sprung slightly, thus making it cut better by increasing the "belly" in it. This is not a comfortable position for the hand, but is necessary sometimes when using a thin file.

In filing a very broad surface it is necessary to use a special handle, which grips the sides of the tang and hooks over the point and has a brace in the middle, thus leaving the whole under surface clear while the brace in the middle prevents the file from springing to a concave form and cutting on the ends instead of the middle, as it should. The work also should be placed low, so the workman can reach all parts of it and put the required pressure on the file.

Ordinary work should be placed at about the height of the workman's elbow so the forearm will move in almost a horizontal line. Fine, delicate work should be placed higher, as it is more readily inspected in this position.

Draw-filing is accomplished by moving the file at right angles to its axis, and is used almost exclusively for finishing, as it removes the metal very slowly, though it leaves a smooth finish. Draw-filing does not require much skill, and creditable work may be performed after a little practice, but cross-filing, especially on smooth plane surfaces, requires much experience and skill.

The character of the work and the finish required, of course, determine the coarseness of the file that should be used, but the "bastard," "second-cut" and "smooth" are generally used on general work. A fine-cut file will take hold of the harder metals better than the coarser files, and leaves a smoother surface.

The file should be kept free from cuttings which lodge between the teeth. When they cannot be removed by tapping the edge of the file against the vise, they should be brushed out with a file card or brush, or, as is sometimes necessary when working on wrought iron or steel, with a soft iron or copper scorer. The pieces will sometimes project above the teeth of the file and cause deep scratches in the work. This trouble, or "pinning" as it is called, may be lessened by thoroughly chalking the file, though this prevents it from cutting so freely.

Care should be taken when filing work in a lathe that it is not run too fast. Ordinarily the motion of a file is comparatively slow, averaging probably forty strokes of eight inches length per minute, or about fifty feet per minute, and, as the teeth do not cut on the back stroke, time is allowed for cooling and the file does not become hot. In filing work in a lathe, the number of strokes is not increased, but the length is greatly increased, as the speed of the work must be added to the actual length of the file. As the whole length of the file, however, is usually used in filing rotating work, the bad effects of the high speed are greatly reduced. The file should not be held stationary, and the work be allowed to revolve against it, as only a few teeth will then do all the work and it is very liable to result in grooved work. The side motion previously spoken of in cross-filing should also be given the file. As it is almost impossible to keep a piece of work true when filing it in a lathe, it should not be filed more than is necessary to obtain the finish desired.

A safety edge file is one having one or both edges without teeth, which enables one to file one of two sides of an angle without injury to the other. It is well, however, to run the safety edge over an emery wheel before using, as the teeth are expanded over the edge in cutting and may mar the work. An ordinary file may be made safe by grinding the teeth off one side on an emery wheel.

A new file should never be used on very narrow work, as the teeth take hold too freely and will be broken out, ruining the file. Narrow work also should be held as close to the vise jaws as possible to prevent vibration or chattering.

If a new file is to be used to make a very fine finish, it should be rubbed over very lightly with an oil-stone, as, in cutting, some of the teeth will be raised slightly above the general surface of the file and will score the work. In some places, where absolutely true surfaces are produced with files, special smooth files are used, and these are further prepared by an expert, who makes a light stroke with it over a flat brass plate.

The high teeth can then be told by the brass adhering to or discoloring them slightly, and these high teeth are now touched with a drop of acid compound and laid aside for a few minutes while another is being treated. It is then dipped in water to stop the action of the acid and again given a stroke on the brass plate and an acid treatment until no tooth is higher than the others. With files so prepared, one employe of an air-brake company will face the seat of a slide valve of part of the air brake apparatus while another will face the valve itself. These parts are assembled without being fitted together either by scraping or grinding, and will be absolutely air-tight under an air pressure of eighty pounds per square inch. This valve is not lubricated or packed with oil, but is perfectly clean and dry except for a very light coat of the finest graphite, which is used as a lubricant.

As it is impossible to file straight and true with a dull file, a good mechanic will take care of his files, using them on the finest work first and on the rougher work when dulled, in this way getting the full use from the file and always having a good one when needed for a particular job. They should not be thrown in the drawer with hammers, wrenches and other tools, nor piled indiscriminately together, but be laid away carefully; if possible, being separated by wood partitions, or wrapped in cloth. This is particularly so where a workman has special files for special work, as these are very expensive and should be given good care.

In filing concave surfaces, as in fitting a driving box or rod brass, a half-round file is not so good to use as a square or "crossing" file, as either of these is much easier to keep from rocking than a half-round. The edges of the square file will do all the cutting, of course, but it will cut very rapidly, and, as it has considerable "belly," it can be made to cut just where it is needed. In using the "crossing" file on concave work, use the side with the arc of the larger curve, so just the edges will touch first and finish with the other side of which the round part may be made to do the work.—*Scenic Lines Employes' Magazine.*

THE TRAILING-TRUCK

Looking back over the course of many years there will be found few individual developments in American locomotive practice which have enabled such advances to be made as those rendered possible by the trailing-truck. The American designer is somewhat inclined to go his own way, regardless of others, until one day he suddenly awakens to the fact that a device well known in other countries might be made to help him over his difficulties. The Mallet articulated compound locomotive is an instance of this. This machine has been known to European practice since 1887. Its existence was ignored in the United States until 1903. It made its first appearance there, after its discovery, so-to-speak, in the form of quite a remarkable engine, the precursor of a series of machines which eclipsed everything attempted before that date. The trailing-truck is another case of the same kind.

Trailing-wheels with some side-play allowance have been used from very early days on "singles" both here and in America. They were also employed on suburban engines, and also on what we termed "mixed-traffic" engines. These are not instances, however, of trailing-trucks in which radial motion is arranged for by means of guides or radius-bars. Radial trailing-wheels were first used here in 1863; Mr. Webb's first application of them on the London and North-Western Railway was made in 1876. Trailing-wheels with side-play allowance were introduced on main-line express engines with more than a single pair of driving-wheels by Mr. Webb in 1891, when the "Greater Britain" class was brought out at Crewe. They appeared almost simultaneously in America on the "Columbia," an engine built by the Baldwin Locomotive Works, of Philadelphia. The "Columbia" and the "Queen-Empress," sister-engine of the "Greater Britain," were exhibited at the Chicago Exhibition. Both were of the 2-4-2 wheel arrangement, but Mr. Webb's engine, of course, had independent, and not coupled, drivers. While promising well at the time, both classes were short-lived, though the "Columbia" had the honor of ushering in a most interesting era of American practice. The engine was the forerunner of the so-popular "Atlantic" type, first brought out in 1895.

It was about this time that American engineers began to take advantage of their liberal gauge-limits, and inaugurated the policy of applying the principles of railway economics to daily operation, as well as first construction. The change, made with a view to reducing transportation costs to the lowest possible figures, immediately bore fruit in the form of a demand for units of greater power. The locomotive of that day was progressively enlarged and made heavier, until the existing types could undergo little further expansion. Although the "Atlantic" type made rapid headway, all that the design implied was not at first realized. On roads using anthracite for passenger work, the "Atlantic" type was quickly adopted. The Lehigh Valley and Philadelphia & Reading engines of this class soon became famous. Though greatly facilitating boiler design, on such engines small trailing-wheels were not, however, absolutely essential, since wide and shallow anthracite fire-box engines of the 4-4-0 and the 4-6-0 types have been designed with coupled wheels, 72 in. in diameter, under the box.

Full benefit was not derived from the small trailing-wheel idea until it was realized that the further development of bituminous-coal-burning boilers along existing lines was impossible. Boilers had been designed with large heating surfaces, but proved rather unsatisfactory and uneconomical owing to restrictions at the fire-box end. The usual bituminous-coal-burning boiler had a long and narrow box resting on the top of the bar-frames. As an extreme example of this class of boiler the large Pittsburgh, Bessemer & Lake Erie "Consolidations" may be mentioned. This design held the record for being the largest in the world for some time. It was brought out fifteen years ago, and the engines, which weighed 250,300 lb. without tender, had a heating surface of 3805 sq. ft. and a grate area of 36.8 sq. ft., the grate being 11 ft. long. It was realized that such long and narrow grates could not be economically fired, but there seemed to be no way of getting over this fact until designers broke fresh ground and introduced a shorter and moderately wide box extending over the frames. But the difficulties were not over. Such a box could be advantageously applied to the "Atlantic" class, but on the other existing classes it was limited, of course, in depth, a drawback in the case of bituminous coal. Nevertheless, it came into use, even where it had to be placed over the driving-wheels, as preferable to the narrow box, and it has established itself securely in favor. An idea of the developments which this change has rendered possible may be gathered by comparing the figures given above with the chief particulars of recent "Consolidation" engines built for the Wheeling & Lake Erie. These engines are the largest of this type. They weigh 266,500 lb., without tender of course, and have 3517 sq. ft. of heating surface, and, in addition, 774 sq. ft. of super-heating surface, the grate area being 66.75 sq. ft. The P. B. & L. E. design of 1900 had a ratio of heating surface to grate area of about 100; in the modern "Consolidation" the ratio is usually about 70.

Recent investigations have all gone to confirm the deductions drawn from early experiments with regard to the value of the fire-box end of a locomotive boiler, compared with the smoke-box end, as regards evaporation. American designers have followed this up. About 1900 an adaptation of the Webb radial box was applied to the trailing end of an "Atlantic"-type engine, instead of merely allowing the trailing-wheels a certain amount of side play. The trailing-truck, as subsequently developed, is now a feature of all the larger engines of that class, and it has rendered possible immense developments in other classes. Before it became popular, the classes were practically confined to the following:—American type (4-4-0); Ten-Wheeler (4-6-0); "Mogul" (2-6-0); "Consolidation" (2-8-0); "Decapod" (2-10-0). The 4-4-0 type had developed into the 4-4-2 before its adoption. The next change came to the "Mogul" class. Fitted with a trailing-truck it became a 2-6-2, and was known as the "Prairie" type. Though never attaining to any great degree of popularity, this type produced some notable examples of design. The most famous were perhaps some engines on the Lake Shore & Michigan Southern with 79-in. drivers, while the heaviest were built for the Atchison, Topeka & Santa Fe. Alongside the 4-4-0 type, the "ten-wheeler" (4-6-0) was developed for heavy passenger work, but this class was also handicapped as regards boiler capacity. The latter remark applies also to the 2-8-0 and the 2-10-0 types after they had reached a certain size. In all these cases the principal development of late years has been the provision of additional boiler capacity, rendered possible, in spite of the long wheel-base, by the adoption of the trailing-truck. The types have now expanded into the 4-6-2 ("Pacific"), the 2-8-2 ("Mikado"), and the 2-10-2 ("Santa Fe"). The boiler has benefited proportionately. The trailing-truck allows an additional weight to the engine of 50,000 lb. or more without increasing axle-loading. Most of this can be put into the boiler.

Some years ago the largest examples of freight engines

were of the 4-8-0 type. This type was built in some numbers, but had manifest disadvantages. Compared with the 2-8-0 engine, the ratio of total weight to adhesive weight was unsatisfactory. It allowed, however, an increase in boiler capacity, but only at the front end. The modern freight engine of the "Mikado" class, while its equal as regards the number of coupled and non-coupled wheels, is far superior in boiler power. A large twelve-wheeler had about 3500 sq. ft. of heating surface. A modern "Mikado" may have 5500 sq. ft. much better disposed. The 4-8-0 has been expanded to the 4-8-2 type, used, as its name implies, on "Mountain" divisions, for passenger work, but not to any very great extent. The limit to such classes as the 4-4-2, 4-6-2, 2-6-2, 2-8-2, is not now concerned with boiler capacity. The trailing-truck has enabled boilers to be designed fully up to the work required. The limit in these cases is set by the allowable wheel-loads. The length to which American designers go, however, in this direction may be gauged by the fact that the Baltimore & Ohio have some 2-10-2 engines in service with 67,000 lb. on each pair of drivers.

Statistics of the American locomotive industry for recent years show that the classes of which most are now built are the 2-8-2 class for freight, and the 4-6-2 for passenger work. Some of these freight engines have boilers ranging from 5000 sq. ft. to 6900 sq. ft. of heating surface, or of heating and superheating surface. A little figuring will show that it is beyond the capacity of a fireman to keep saturated-steam boilers of such size going at maximum capacity. The trailing-truck, therefore, which has rendered such machines possible, has made it necessary to devote increased attention to other points. To lighten the work of the fireman, economy-producing systems have been adopted, or resort has been had to mechanical operation, or both. The realization of the fact that many of the large boilers introduced a few years ago have been underfired has probably helped superheating along in the States as much as anything else. The same may be said of mechanical firing, tests on the Pennsylvania Railroad having shown that greatly increased output was obtainable from some of their large engines when machine-stokers supplied the grate with all the coal it could burn, the amount being well beyond that which a fireman could handle.

Everything which helps to increase the output per pound of coal, or render the output independent of the physical disabilities of the attendant, is, therefore, to be considered in a light quite different from that in which these things were viewed in days before the locomotive had grown to its present size. Then little care was taken to ensure the satisfactory use of the coal fired. Nowadays, however, the Gaines fire-box, arch-tubes, brick arch, combustion-chamber, superheating and feed-water heating, are all accepted as helping towards the solution sought, and therefore to be studied with a view to bringing about further improvements. In addition to allowing greater latitude of design and the production of more efficient fire-boxes, the trailing-truck has brought with it increased tube-lengths, with correspondingly lower smoke-box temperatures. Its influence on the size of boilers, which we have pointed out, has stimulated the evolution of all sorts of mechanical means of performing operations formerly effected by hand. The American locomotive of today is covered with such contrivances. There are power-operated stokers, fire-door openers, grate-rockers, reversing-gear, bell-ringers, coal-pushers on the tender to keep the supply within reach of the fireman, and so on.

The efforts made to whittle down the weight of machine parts, in order to put more into the boiler, which first came into evidence just before the possibilities of the trailing-truck were realized, have fortunately been persisted in the while, and the American locomotive of today is, generally speaking, a carefully-thought-out machine. Had we space, we might refer to many notable examples of very thorough design of recent years; of instances of the saving of weight in directions in which formerly certain designs were accepted as orthodox and practically unchangeable; and of cases in which excellent progress has been made in the matter of applying in practice recent teachings of metallurgical research—all with the object of benefiting, directly or indirectly, the boiler portion of the locomotive. It cannot be claimed that all these improvements, which are being carried through practically all classes, including the big Mallet compounds, are the direct result of the development of the trailing-truck. Indirectly, however, they may safely be said to be so, as we have been able to show above, since had it not been for the great increase in boiler power thus rendered possible, it is improbable that these matters would have been brought so prominently into notice, in a country where coal economy *per se* was for long not seriously considered on the railways.—*Engineering*, of London, Eng.

SAFETY WORK, B. & O. R. R.

In a review of the "Safety First" campaign conducted by the Baltimore & Ohio system during 1914, a report issued by the general safety committee shows that 91 per cent of all items recommended to improve safety conditions was disposed of by the company. Recommendations totaling 9,256 items were made by 698 employes who are members of safety committees on 23 divisions throughout the territory served by the railroad. The Ohio River committee, whose headquarters are at Parkersburg, W. Va., disposed of 91 out of every 100 of the 892 recommendations made. The Ohio committee, with offices at Chillicothe, O., led in percentage of cases disposed of with an average of 97 per cent on a total of 448 items recommended. The Chicago Terminal division was second with 96 per cent of the items corrected. Showing the co-operation between the employes and management of the Baltimore & Ohio, the first American railroad to establish a "Safety First" department upon ideas originated by the Chicago & Northwestern railroad, the report shows that on no division of the system did the percentage of recommendations adopted during the year fall below eighty.

Drill Press for University Test Work

A high production drill press has recently been installed in the machine shop of the College of Engineering at the University of Illinois. This press is to be used in a series of tests on drilling in metals. The machine is of heavy construction, weighing 2,600 pounds, and has sufficient power to drive drills of high-speed steel to their ultimate capacity.

At the highest rate of production the machine forces drills through cast iron at the rate of 53 inches per minute. This is from three to five times the rate for ordinary drill presses, and almost equal to the rate of drilling wood a few years ago. The machine is of the all-geared type, no belts being used for power drive for any part of the machine. This geared drive eliminates the chance of slippage between motor and drill. All gears run in a bath of oil, and the machine is equipped with a circulating oil pump. This machine is equipped with a 7½ horsepower motor.

Some Interesting Old-Time Locomotives

Eight Examples of Types Used in the Period from 1857 to 1891, Showing Products of the Early Designers

By Arthur Curran.

In reviewing some of the more important steps in the progress of locomotive engineering, it is advisable to confine comment to those engines which have not been exploited elsewhere.

It is on this account that I ignore the very early and the very recent history of railway motive power. Further than this it is merely necessary to state, by way of introduction, that the eight-wheel, or American, engine was the most popular type on the railroads in this country up to within comparatively recent years.

Fig. 1 shows an interesting old-time example of this type built by John Souther of Boston in 1857 for the Pittsburgh, Fort Wayne and Chicago Railway. The cylinders of this engine were 14x22 inches, the drivers were 56 inches in diameter, and the total weight of engine was 60,000 pounds. This engine was an "insider," a type much favored by New England builders years ago. The merits of the "inside-connected" type were never very obvious, and the design was, of course, abandoned. But many engines of this type were built while the fad lasted.

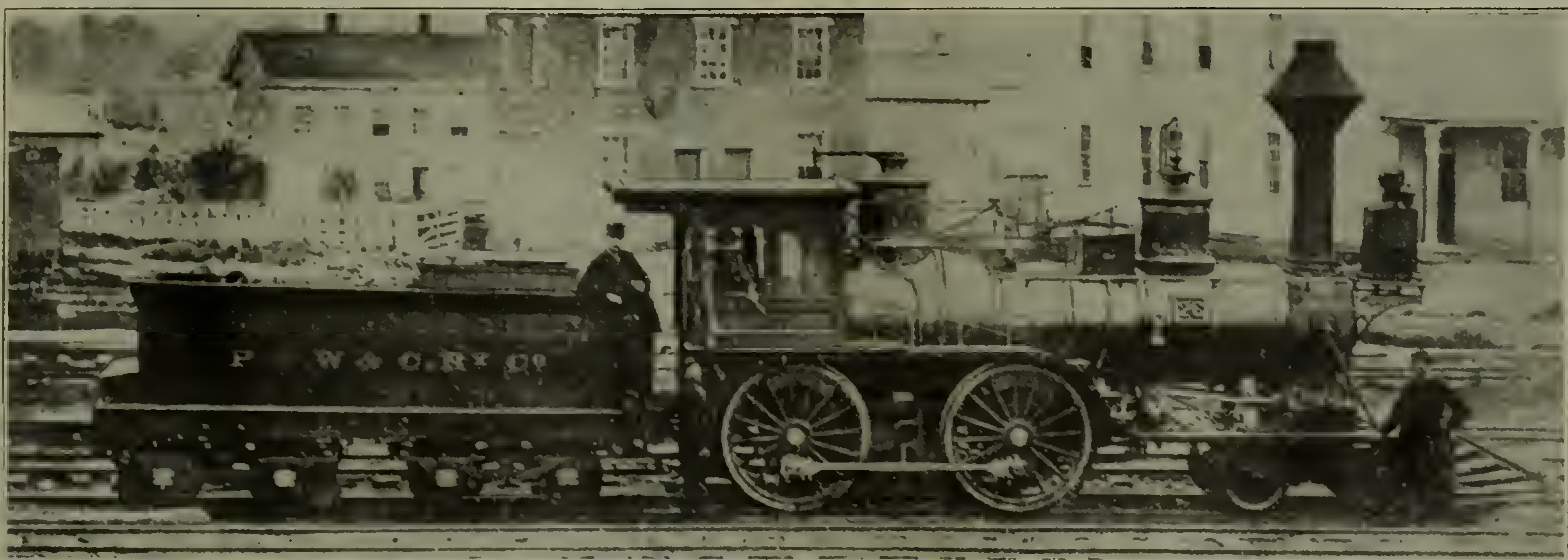


Fig. 1—Inside Connected Locomotive Built in 1857.

Fig. 2 shows the David Upton, an old Hudson River engine, built by the Schenectady Locomotive Works. The cylinders of this engine were 16x22 inches, and the drivers were 72 inches in diameter. Little appears to be known about this locomotive, but in view of the fact that she had inclined cylinders it would seem probable that the date of her construction was not many years later than that of the engine shown in Fig. 1. In any case, the David Upton is a good example of old-time designing.

Among the builders who were prominent years ago, William Mason was one of the best and most favorably known. He was specially noted for his refined designing; but, aside from this, will be remembered for the "bogie" engines which he tried to popularize. As a matter of fact, he sold a considerable number of these engines, and they appeared to get along very well on some of the roads that used them. It may be recalled that the object sought in designing this style of engine was power combined with flexibility. The latter was obtained by a form of construction which permitted the drivers to swivel like a truck. Lack of space precludes a description of this feature, but Fig. 3 gives a good idea of the general appearance of a "bogie." This engine was completed on May 9, 1874, for the Erie, and was the only engine that Mason built for that road. The cylinders were 15x22 inches, and the drivers were 48 inches in diameter. Like most of Mason's "bogies," this engine

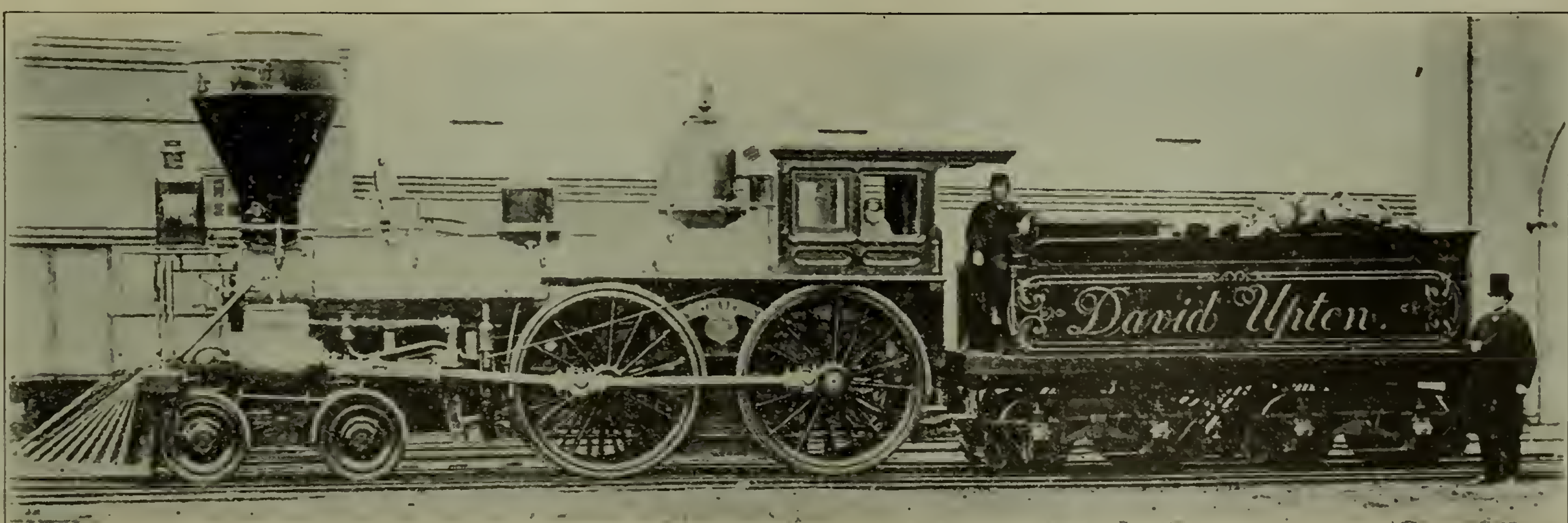


Fig. 2—The David Upton, an Old Hudson River Engine.

Fig. 3—Locomotive Built for the Erie in 1874, Having Swivel Drivers.

was very handsomely finished, and the lettering and striping were elaborate.

The "bogie" type did not survive, but the idea which it represented reappeared years later when the Mallet found favor on some roads.

Fig. 4 shows No. 237 of the New York Central and Hudson River Railroad. This engine is of interest as a development of the David Upton, and represents a later period, as may be observed by the "cap" stack, extension front and horizontal cylinders. Furthermore, it is a design which, with gradual increases in weight and minor modifications, remained a favorite on the Central clear up to 1890. Engines of similar design, but somewhat heavier, were hauling important trains as late as 1896—perhaps later.

Fig. 5 shows No. 39 of the New York, New Haven & Hartford Railroad. This engine was built at the New Haven shops in 1876 and was an eight-wheeler belonging to class D-16. The cylinders of this engine were 17x22 inches, drivers 69 inches in diameter, and total weight 74,000 pounds. It will be observed that the photograph was taken when the sand-box of the engine was being filled. The method of doing this presents an interesting contrast to the manner of accomplishing the same result today at a modern engine terminal.

Fig. 5—No. 39 of the N. Y., N. H. & H., Built in 1876.

Fig. 4—No. 237 of the N. Y. C. & H. R. R.

Fig. 6 shows No. 65 of the Fitchburg Railroad. This engine was turned out by Mason on July 10, 1877, and had 17x24-inch cylinders and 60-inch drivers. This was a typical standard Mason engine, and is an excellent example of that builder's admirable sense of proportion.

Fig. 7 shows No. 147 of the Old Colony Railroad. This was a class H engine built in 1889 at the company's shops. The cylinders were 18x24 inches, drivers 66 inches, and total weight 97,800 pounds.

Fig. 6—No. 65 of the Fitchburg R. R.

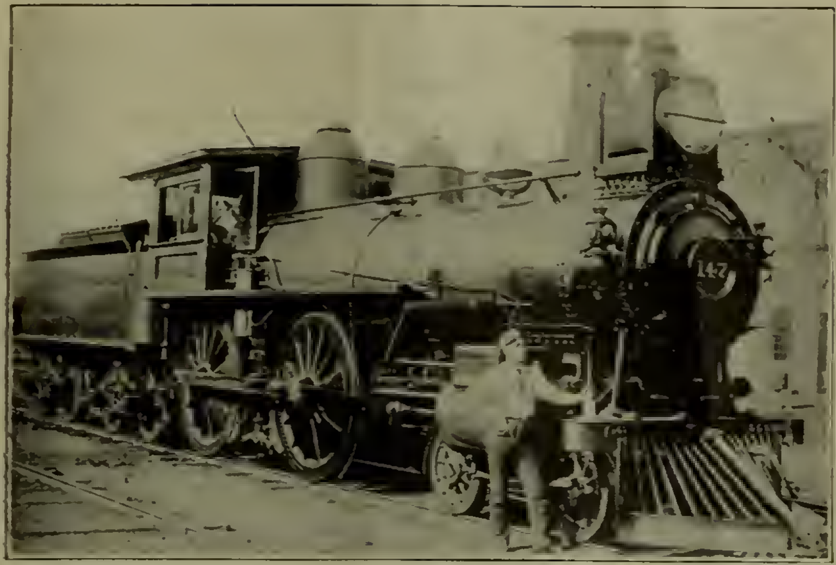


Fig. 7—No. 147 of the Old Colony R. R.

The Old Colony appears to have enjoyed a reputation for fast running in its palmy days, especially in connection with its "boat trains" run between Boston and Fall River. Many stories are told of wild rides on this particular run, and of a Mr. Lauder, whose work as head of the motive power department made them possible. Judging by the remarks of his admirers, Lauder must have been a remarkable man, and capable of performing the most amazing engineering feats.

No account of motive power development, however brief, would be complete without some mention of the splendid work done by William Buchanan during the time that he made history on the New York Central. The general public will remember him chiefly for his celebrated 999, but that engine represented but a small portion of his mechanical achievements.

One of the best engines that he ever designed was the 870, shown in Fig. 8. This engine was built by the Schenectady Locomotive Works in 1891, and had 19x24-inch cylinders, 78-inch drivers, and a weight of 120,000 pounds. The photograph was taken about 1895, after the engine had been modified in certain minor details. The cylindrical headlight, extended piston rods and pilot coupler are the principal details referred to; but the panel under the cab windows had also been changed to conform to a more recent practice. The finish of the engine was somewhat improved, probably because she was used on the Empire State Express.

This engine is of further interest as the subject of considerable controversy. It seems that because of the changes herein mentioned, some persons got the idea that there were two 870s. From what I know of the Central, I do not believe that such was the case. However, the publication of this photograph—which is rather rare—may clear up the mystery.

Fig. 8—No. 870 of the N. Y. C. & H. R. R. R., Built in 1891.

The foregoing comment, though brief, should be sufficient to explain certain phases of motive power development. The photographs tell the story better than pages of text possibly could. The pictures are of special value because, to the best of my knowledge and belief, they have not been published elsewhere.

To those who find profit and entertainment in an occasional glance backward at the lessons of the past, as well as to those who have happy memories of the "scoop" or of the "right side"—or both—this glimpse of the "mills" that bossed American railroads from the fifties to the nineties may be welcome and acceptable.

In any case, it is sure to secure the approval of a certain "stove committee" which believes that the present can never equal the "good old times."

CO-OPERATION

Let your mind for a moment run over the details, with which you are all so familiar. of the activities that go to make up our profession of railroad service of today. From the first conception of a line based upon the co-operative needs of a widely dispersed population for means of intercommunication, up through every grade of preliminary financing, construction, equipping and operating, the measure of success depends upon the intelligent co-operation of the many minds and wills concerned in the enterprise, and the more perfect the co-operation, the more harmonious the diversified activities concerned, the greater the success. Bring home to yourself and to your own desk an individual thought on what real co-operation means. No one here works alone or independently. You all handle phases of questions that originate elsewhere or originate matters that are handled by others. No one of you begins and ends a question or a completed subject. Someone else is concerned in every professional matter that enters into your daily life and work. Do you stop to think how you can make it easier for the other man to intelligently comprehend and successfully accomplish his duty in the work in which you are jointly concerned. That is the effort required of you; that is elemental co-operation, and that very effort in its effect upon the other mind sets in motion an impulse that never ceases through all eternity, for in its acceleration of the activities of the next mind it promotes increased efficiency which again and again is reflected in the successive hands through which every originated thought or act must pass.

Our work in this great profession of ours takes in almost every phase of present day human effort and all of it in its great variety passes at some time or other through your hands, from the constructive and progressive ideas originated by our presidents down to the simple duties performed by the humblest laborer on our roadways, and through it all in every thought or action lies the requirement of intelligent co-operation to insure success. The impress of every mind and every hand concerned in the progress of each interwoven activity is seen or felt by every other mind and hand and if the application in each individual case is made with the constant thought of helpfulness and thoroughness the true spirt of co-operation will have prevailed in the work done, with its consequent far-reaching benefit to you individually, to all of those equally concerned and interested in your work, and to the company to whose welfare your best thought is given and to whose success your most intelligent effort should be directed.—*F. B. Lincoln, Genl. Supt., Erie R. R. before the Railroad Men's Improvement Society.*

DON'TS FOR BRAKEMEN

By Frank J. Borer, Fmn., Cent. R. R. of N. J.

Don't part the air hose couplings by hand before separating cars, as that would increase the life of the air hose and would be a saving for your employer.

When taking on or discharging passengers always post yourself so as to assist young ladies only, as the old people can take care of themselves and their hand baggage, or maybe some kind passenger will give them a "hand."

If passengers should ask you for information, stare at them first, then realizing that the traveling public really knows less about railroading than you do, display an overabundance of anger and contempt and give them as little information as you can, for you are no walking encyclopedia.

Don't hang up the steam hose when not in use, because by so doing the coupling would not become damaged and you might strain your back.

If there should be some breakdown on the engine, don't go anywhere near it, as some one may ask you to help a little to shorten up the delay of train, which, however, does not bother you, for you are paid to ride on the train.

If you notice a hot box, don't tell the conductor about it, because he may be mean enough to order you to repack the box.

If you notice a stuck brake, keep it to yourself, because it cannot do any harm (to you) if you ride on the cars ahead of it; besides, these new engines are used to pulling "extra" loads, and it gives the shops something to do in removing slid flat wheels.

And last, but not least, don't look out for your employer's interests, but expect him to look out for yours.

An Extensive Electric Exhibit

The exhibit of the General Electric Company in the transportation building at the Panama-Pacific International exposition is very extensive and comprises electric locomotives for various classes of service including steam railroad electrification, railway motors and all kinds of apparatus and accessories for electric railways, signal accessory electric devices, electric apparatus and equipment for railway shops, electric illumination for cars and shops, etc.

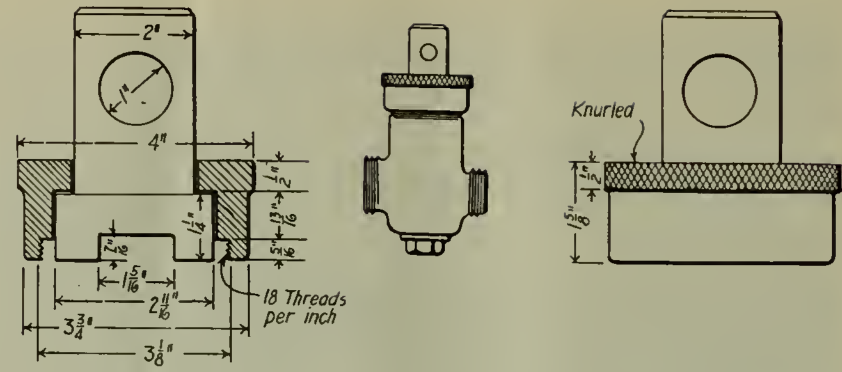
Removing Controlling Valve Chambers

By F. W. Bentley, Jr.

The controlling valve chamber of the Leslie steam heat reducing valve, class B, is often something of a proposition in removal. Various types of socket wrenches generally used to start the chamber out of the body are adequate to be sure, if they are a snug fit on the wrench lug on top of the chamber casting. It is very often found on valves that have been in service some length of time, however, that the tops of such wrench lugs are rounded off, making it impossible to get a socket wrench turned with a bar to loosen the chamber. The wrench is prone to, and often does, slip off, injuring the thin upper walls of the governor body.

The sketches show a form of combination, nut and wrench for removing the chambers, with the use of which there is no opportunity for the wrench to slip off of the lug no matter how badly it may be rounded off in former mishaps with various types of socket wrench.

The nut follows the socket end of the wrench down until it lacks about 1/32″ or 1/16″ of becoming tight on the top of the chamber. The nut now keeps the wrench from slipping up with no danger to any other



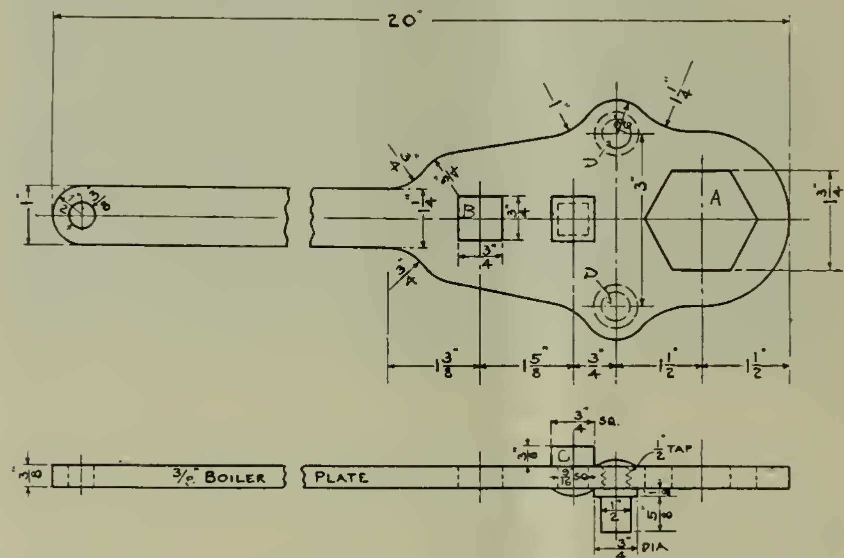
Wrench for Removing Controlling Valve Chambers.

part of the body. When the chamber has been turned until the wrench tightens on the top inside face of the nut, the chamber is then invariably loose enough so that the retaining nut may be removed and the chamber screwed the rest of the way out with the fingers or a light monkey wrench. The combination nut wrench is also used to hold the socket in reapplying the repaired chamber to the inside of the valve.

The parts of the wrench are easy to make and will afford much safety and convenience in this feature of the work on the class B valve.

Wrench for Westinghouse Feed Valve

In order to facilitate repair work in his department, George K. Dorwart, airbrake foreman of the Colorado & Southern shops at Denver, designed a wrench for taking apart a Westinghouse feed valve.



Feed Valve Wrench.

It is the only tool necessary to completely dismantle a feed valve, as by holding the cap nut, pc. 8946, in the bench vise the check nut, pc. 1067, and spring box, pc. 1062, are loosened with the hexagonal opening, A; the regulating valve cap nut, pc. 6905, with the square opening, B; the flush nut, pc. 18458, with the square pin, C, and the body from the cap nut by round pins, D, in bracket bolt holes.—*Scenic Lines Employes' Magazine.*

The Extent of Electrification

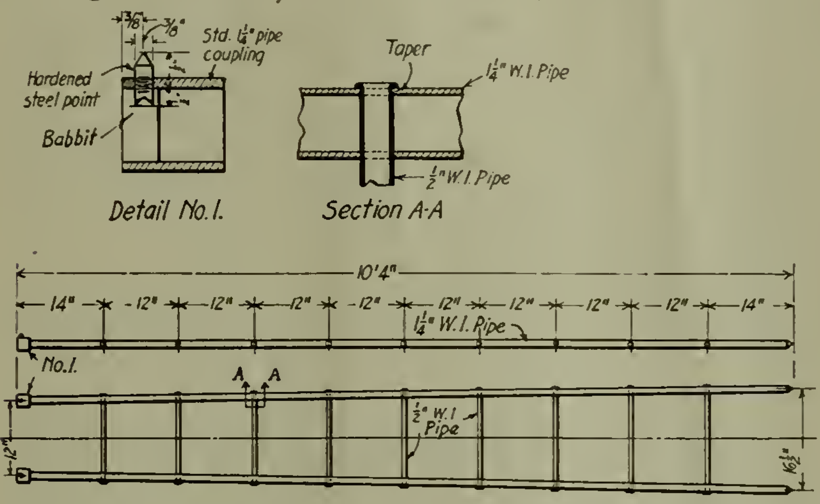
A writer in the *Railway Magazine* of London, England, in an article dealing with steam railway electrification summarizes the extent of such projects as follows:

	Miles electrified (reduced to single track).	No. of electric locomotives.	No. of motor-cars.
United States	2,000	400	1,000
Continent of Europe	1,300	300	350
Great Britain	750	25	650

A CHEAP AND STRONG LADDER

By Edward F. Joyce.

The sketch shows a ladder which has been in use at our shop for the past four months. It is made of second-hand pipe and the cost of labor and material for constructing it amounts to approximately one dollar. This



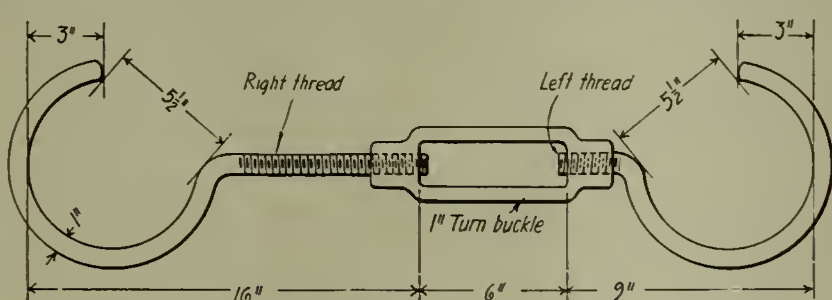
Ladder Made from Second-hand Pipe.

ladder is more substantial than a wooden ladder, inasmuch as it is less liable to break, and it is, therefore, a great improvement from the standpoint of safety. It has proved very satisfactory, particularly in repairs to steel cars, where there is an additional strain thereon, due to men standing on it while driving or bucking up rivets.

BRAKE BEAM ADJUSTING DEVICE

By Frank J. Borer, Fmn., Cent. R. R. of N. J.

For those brake repairmen who are not already using a device similar to the one illustrated, the device shown should be of value as an easy means of adjusting heavy brake beams on passenger cars. It may be made at the



Brake Beam Adjusting Device.

shop at a small cost and its use is very simple. One hook is placed over the brake beam near the center and the other end is hooked over the axle. By tightening up the turnbuckle the brake beam is drawn against the wheel thus enabling the workman to connect the truck lever bottom connecting rod with ease. The device may be made to suit any kind of truck or brake beam. I constructed one similar to that shown, about six years ago, and it has been in constant use ever since.

FUEL VALUE OF WOOD

The fuel value of two pounds of wood is roughly equivalent to that of one pound of coal. This is given as the result of certain calculations now being made in the forest service laboratory of the U. S. Department of Agriculture, which show also about how many cords of certain kinds of wood are required to obtain an amount of heat equal to that of a ton of coal.

Certain kinds of wood, such as hickory, oak, beech, birch, hard maple, ash, elm, locust, longleaf pine and cherry, have fairly high heat values, and only one cord of seasoned wood of these species is required to equal one ton of good coal.

It takes a cord and a half of shortleaf pine, hemlock, red gum, Douglas fir, sycamore and soft maple to equal a ton of coal, and two cords of cedar, redwood, poplar, catalpa, Norway pine, cypress, basswood, spruce and white pine.

Equal weights of dry, non-resinous woods, however, are said to have practically the same heat value regardless of species, and as a consequence it can be stated as a general proposition that the heavier the wood the more heat to the cord. Weight for weight, however, there is very little difference between various species; the average heat for all that have been calculated is 4,600 calories or heat units per kilogram. A kilogram of resin will develop 9,400 heat units, or about twice the average for wood. As a consequence, resinous woods have a greater heat value per pound than non-resinous woods, and this increased value varies, of course, with the resin content.

Causes of Honeycomb on Flue Sheets

The formation of honeycomb on flue sheets is doubtless contributed to by the presence of excess ash material and sulphur in the fuel. In this connection it is interesting to note that the fine material produced in the ordinary process of mining has a higher percentage of both ash and pyrites (iron sulphide) than is present in lump coal taken from the same mine. In a series of tests conducted by Prof. S. W. Parr, of the University of Illinois, on samples of coal from seventy-five mines in that State, each mine being represented by one sample of screened lump coal and one of screenings, the results showed an almost uniform ash percentage in the screenings, at least double that of the ash in the lump coal. In run-of-mine coal the product is somewhat deceiving, having the appearance in the mass of being very largely lump material. Of course, it is possible for occasional carloads of run-of-mine coal to be fully equal to the best screened lump from the same mine, but the fine material must sooner or later come along somewhere in the output. After the blast and the breaking down of the coal at the working face the miners enter and clean up the rooms by sending out first the coarse or lump material. At the clean-up, which is made before the new drill holes are started, that part of the underlying floor which has been more or less pulverized and loosened in the various processes is shoveled up and sent out along with the coal. In this way it is evident that the fine material will be much higher in ash and will, moreover, contain mineral constituents which usually are in themselves higher in sulphur. Therefore, in run-of-mine material there will often occur exactly those physical conditions of fineness of division and high content of iron pyrites which are productive of pasty articles that can be made to grow by small accretions, finally forming a honeycomb structure on the flue sheets.—*Electrical World.*

REVIEWS OF RECENT BOOKS

Handbook of Tables and Formulas for Engineers. By Clarence A. Peirce and Walter B. Carver. Leather, 4 in. x 7 in., 168 pages. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price, $1.50.

This handy little book is exactly what its name implies. It was originally intended to meet the needs of engineering students at Cornell university and for this reason a number of pages are devoted to equations in algebra, geometry and calculus, which the practicing engineer probably would refer to but infrequently. However, the major portion of the book contains a large number of formulas and tables which the engineer continually wishes

to refer to. The authors do not claim originality for them. They are the formulas found in a number of other well known volumes, but they are given here without any lengthy explanations and are so arranged that they can be referred to quickly. Besides the mathematical sections, there are sections on measurement, physical and chemical properties of substances, mechanics, strength of materials, standard gauges, fastenings and flanges and mathematical tables. As a concise book for quick reference for the engineer who knows what he wants, this book is recommended.

* * *

The Art of Estimating. By William B. Ferguson, naval constructor, U. S. N. Cloth, 5 in. x 8 in., 97 pages. Published by The Engineering Magazine Co., 140 Nassau St., New York.

The author is head of the construction department of the Charleston navy yard and while he illustrates his ideas by examples of handling navy construction work, yet the points brought out are so clear that they can be applied in estimating the cost of work in other lines as well. As the book states, "the main point to emphasize is that each plant must collect its own data," careful analysis of which will greatly facilitate estimate work. The method of reducing estimating data to the form of curves is gone into, together with piece work prices, symbolizing labor operations, planning and estimating by operations, and estimating overhead expense. Several pages are devoted to the development of an estimating section.

* * *

Universal Safety Standards. By Carl M. Hansen, consulting safety engineer, American Society of Mechanical Engineers. Leather, 5 in. x 8 in., 312 pages, illustrated. Published by the Universal Safety Standards Publishing Co., 12th and Race Sts., Philadelphia, Pa. Price, $3.00.

This volume was compiled under the direction and approved by the Workmen's Compensation Bureau and is now in its second edition. The volume is divided into four sections, namely: general safety standards, the machine shop, the foundry and rules for practice. Each of the first three sections contains many subdivisions (as for instance boring and turning mills), followed by a certain number of suggestions for safeguarding the particular subject mentioned. The illustrations showing the safeguards in green follow at the end of each chapter and they explain themselves readily. They show methods of safeguarding a great number of danger points in machine shop and foundry work and for the many now interested in safety work the book should prove very helpful.

* * *

Railway Economics. A collective catalogue of books in fourteen American libraries. Cloth, 7 in. x 10 in., 446 pages. Prepared by the Bureau of Railway Economics, Washington, D. C.

The purpose of this volume is to provide those interested in the study of railway transportation and economics, a catalogue whereby they may be enabled to gain access to a majority of the literature on the subject. Although there are many papers, reports, documents and pamphlets buried in various libraries, there has been no comprehensive catalogue of this matter. The volume is divided into the following catalogue sections: general works on special topics; administration; construction and operation; traffic; railways of respective countries, and railway periodicals and proceedings. Its compilation was a task well worth while and its use should enable students of railway economics to gain a better and clearer understanding of railway transportation. The Bureau of Railway Economics, which undertook the preparation of this volume, was established in 1910 by the railways of the United States for the scientific study of transportation problems.

REORGANIZATION OF THE U-S-L CO.

In the proceedings before Judge Hazel of the U. S. District Court of the Western District of New York, in Buffalo, March 30, the receivers announced to the court that a complete reorganization of the United States Light and Heating Company is now assured through the efforts of the stockholders' protective committee. It appears that the latter represent over $2,000,000 of the $2,500,000 outstanding preferred stock and about $6,000,000 common stock, giving them the majority control.

The application of the receivers was for the purpose of advising Judge Hazel to wind up the receivership and transfer the business and the property to the reorganized company.

It is understood that necessary notification to the stockholders and others will take some little time, and it appears, therefore, that the receivership will be discontinued some time in June. In the meantime, the business will be conducted without interruption under the same operating management as heretofore, and the prospects for a large volume of business seem unusually bright. The receivership was instituted at a time of greatest business depression, during July, last year, and has continued successfully even despite the adverse circumstances of receivership and the war abroad. The company has made a showing that has been regarded as remarkable. Judge Hazel congratulated the receivers and their attorneys upon the successful outcome of the case.

The mammoth plant at Niagara Falls has been doing a larger volume of business during the present month than for a year past, and orders booked for future deliveries are considered satisfactory. With the future of the company now assured, there will be a larger increase of orders that have been pending for some time past on account of the uncertainty in connection with the destinies of the company, which are now happily settled and which will result in the continued employment of a large body of men. As is usual in similar cases, the receivers will be authorized to sell the assets of the company, and, as stated before, the stockholders' reorganization committee will purchase same for the benefit of creditors and the preferred and common stockholders whom they represent.

The receivers of the company are James A. Roberts of New York City, James O. Moore of Buffalo, and J. Allan Smith of Niagara Falls, N. Y.

PERSONALS

J. W. Johnson succeeds J. T. Tadlock as master mechanic of the *Arkansas, Louisiana & Gulf,* with headquarters at Monroe, La.

John E. Woods has been appointed general foreman of the *Baltimore & Ohio* (Staten Island Lines), with office at Clifton (Stapleton, S. I.), N. Y.

Charles D. Wilder has been appointed boiler foreman of the *Baltimore & Ohio* (Staten Island Lines), with office at Clifton (Stapleton, S. I.), N. Y.

R. A. Miller succeeds W. G. Rodden as general foreman of the *Canadian Northern* at Trenton, Ont.

E. G. Theobald has been appointed car foreman of the *Canadian Northern* at Joliette, Que.

J. L. Hodgson, car foreman of the *Canadian Northern,* has been transferred from Joliette, Que., to Montreal, succeeding R. Moore, assigned to other duties.

T. W. Marshall succeeds H. Dibley as assistant car foreman of the *Canadian Pacific* at Transcona, Man.

Lacey R. Johnson has been appointed general welfare agent of the *Canadian Pacific* with office at Montreal, Que. Mr. Johnson was formerly general superintendent of the Angus shops district, having risen through the mechanical department. In his new work he will co-operate in the development of such organizations as the St. John Ambulance Association, the safety first movement, the Railroad Y. M. C. A., and the athletic associations.

A. Young, whose appointment as master mechanic of the *Chicago, Milwaukee & St. Paul* was announced in the March issue, was born in 1874 and received his education in the public schools at Milwaukee, Wis. He commenced railway work with the *Chicago, Milwaukee & St. Paul,* later completing a machinist's apprentice course. He remained with this road until 1898, serving as a machinist and at that time left the railway service to become an engineer in the Milwaukee fire department. In 1902 he re-entered the employ of the Milwaukee road as a machinist at the Milwaukee shops and in 1905 was transferred to the roundhouse service, being promoted to general roundhouse foreman in 1909. In July, 1913, he was transferred to Chicago as general foreman, where he served until his recent appointment.

G. P. Goodrich, master mechanic of the *Fort Smith & Western* at Fort Smith, Ark., has resigned.

A. Beardshaw succeeds C. Blackbird as locomotive foreman of the *Grand Trunk* at Richmond, Que.

D. Ross has been appointed locomotive foreman of the *Grand Trunk* at Durand, Mich.

C. E. Stewart has been appointed locomotive foreman of the *Grand Trunk Pacific,* with office at Edmonton, Alta.

W. R. Patterson succeeds A. K. Galloway as general foreman of the *Michigan Central* at Detroit, Mich.

W. L. Scott succeeds N. S. Airhart as master mechanic of the *Missouri, Kansas & Texas* at Denison, Tex.

W. G. Humphrey has been appointed purchasing agent for the receivers of the *Missouri, Oklahoma & Gulf,* with headquarters at Muskogee, Okla.

F. T. Hildt of the *Missouri, Oklahoma & Gulf* has been appointed general storekeeper, with headquarters at Muskogee, Okla.

M. F. McCarra has been appointed roundhouse foreman of the *St. Louis Southwestern* at Illmo, Mo., succeeding P. H. Dwyer.

R. R. Young has been appointed general shop foreman of the *Tennessee Central* at Nashville, Tenn.

A. H. Powell has been promoted to general master mechanic of the *Western Pacific,* with headquarters at Sacramento, Cal. He was formerly master mechanic at this point.

OBITUARY

E. P. Gray, formerly general foreman of the *Atchison, Topeka & Santa Fe* at Arkansas City, Kan., died at La Junta, Colo., during the latter part of March.

Charles McCann, general foreman of the *Chicago Junction Railway,* died at Chicago on March 6, at the age of 65 years.

William McIntosh, formerly superintendent of motive power of the *Central of New Jersey,* died on March 15 at his home in Plainfield, N. J. Mr. McIntosh was born on August 20, 1849, at Franklin, Que., and began railway work in 1864 as locomotive fireman on the *Chicago, Milwaukee & St. Paul,* remaining with that road until 1871. He then went to the *St. Paul & Pacific,* now a part of the *Great Northern,* as machinist. From August, 1872, to November, 1877, he was locomotive engineer on the *Chicago & North Western,* and was foreman of locomotive repairs on that road at Waseca, Minn.,

William McIntosh.

and at Huron, S. D., for about ten years. He was appointed master mechanic at Winona, Minn., in July, 1887, and was appointed superintendent of motive power on the *Central of New Jersey* in March, 1899, retiring from that position in 1909. In 1908 he served as president of the American Railway Master Mechanics' Association.

TRIPLEX HYDRAULIC PUMP

The Watson Stillman Company, 50 Church street, New York, has added to its line of high pressure hydraulic pumps a new type of motor-driven geared triplex single-acting pump, which embodies some features of special merit. While primarily designed to meet the severe demands of tunnel service, it will be equally appreciated for other conditions.

To secure unusual compactness and rigidity, and also to insure perfect alignment of all the working parts when under a severe service, the motor is mounted on an extension of a heavy cast-iron base. The driving shaft and bearings are large and are amply provided with lubricating cups. The gears are heavy cut-tooth type. The drive

Triplex Hydraulic Pump.

from the shaft is by eccentrics set at 120°, cast in one piece and keyed with one key to the driving shaft. The eccentric straps are heavy and the plungers are of tool steel and are guided in a rigid crosshead guide, which is keyed and bolted to the base.

The pump body is a machine steel forging with bronze valves and bonnets, and designed to eliminate any air spaces. The passageways are made large to reduce friction of the water to a minimum. The pump as shown is operated by a 10 h. p. motor running at 600 r. p. m. and delivers 100 cubic inches per minute at 3,500 lbs. pressure, with a speed of the crankshaft of 100 r. p. m. Other sizes are built to suit operating conditions.

THE SELLING SIDE

The Bird-Archer Company, 90 West street, New York, manufacturer of boiler chemicals, has opened a St. Louis office at 513 Frisco Building, and a Chicago office at 866 Peoples Gas Building. The St. Louis office is in charge of J. A. McFarland, vice-president, and the Chicago office is in charge of L. F. Wilson, vice-president.

D. R. Niederlander has purchased the business of the Adreon Manufacturing Company, St. Louis, and will continue the same under his own name.

The Remy Electric Company, of Detroit, Mich., is beginning construction of the first unit of its plant estimated to cost $96,075. This unit will be two stories, 50x60 feet, on East Grand boulevard. It will be reinforced concrete and will cost $30,000.

The Stentor Electric Manufacturing Company has moved its office from 1790 Broadway, New York, to 126 Fifth avenue.

The Federal Signal Company, Albany, N. Y., has moved its New York office to 52 Vanderbilt avenue.

Osborn Van Brunt has been appointed manager of the traffic and railway sales of the General Roofing Company, St. Louis. He was for ten years traffic manager of the Simmons Hardware Company, St. Louis, and formerly chief contracting freight agent of the Chicago, Burlington & Quincy.

The Decatur Car Wheel Co., according to report, will invest $200,000 in additions for the building of rogs and switches.

Frank N. Griggs, Richmond, Va., will represent the Harlan & Hollingsworth Corporation for the sale of that company's products and especially passenger rolling stock, beginning April 1. Mr. Grigg's office is Room 1201 Virginia Railway & Power building, Richmond. He also represents the Transportation Utilities Co., Heyworth Brothers & Wakefield Co. and Henry Giessel Co.

The Union Spring & Manufacturing Co. will remove on April 1 from the Oliver building to Suite 2408 First National Bank building, Pittsburgh, Pa.

The American Locomotive Co. has declared the regular quarterly dividend of 1¾ per cent on its preferred stock, payable April 21. Books close April 5 and reopen April 22.

The Chicago Pneumatic Tool Co. has declared the usual quarterly dividend of 1 per cent, payable April 26 to holders of record April 15.

A. Munch, prominently identified with the metallic packing business for a great many years and for the past five years factory manager of the Maywood plant of the Hewitt Co., has been appointed service engineer of the same company. The position of service engineer is a new departure in the railway supply business.

G. Haven Peabody, western representative of the Lima Locomotive Corporation, Lima, Ohio, has resigned, effective April 15, to accept a position with the Lackawanna Steel Co.

Edward J. Williams, treasurer of McCord & Co., has been elected assistant treasurer of the commission for relief in Belgium.

W. C. Chapman, who for several years has been connected with the sales force of the Philadelphia branch office of Manning, Maxwell & Moore, Inc., has been appointed manager of that office.

H. C. Hopson, who for the last six years has been at the head of a department of the New York State Public Service Commission, Second district (Albany), has opened an office at 61 Broadway, New York City, where he is prepared to advise concerning financing, rates, reorganizations, accounting and valuations of railways any other public utilities. At Albany, Mr. Hopson had charge of the examinations of the accounts and records of corporations, in connection with the investigation of capitalization, rates and reorganizations.

E. L. Leeds, who since 1907 has been manager of the railroad equipment department of the Niles-Bement-Pond Co., New York, has been appointed general manager of sales of that company and the Pratt & Whitney Co., Hartford, Conn.

Ralph V. Sage, formerly connected with the Ralston Steel Car Co., Columbus, Ohio, has been made contracting car and structural engineer of the Cambria Steel Co. with headquarters at Philadelphia, a newly created position. Mr. Sage resumes a connection with the Cambria Steel Co. which he previously had severed to go with the Ralston Steel Car Co. Cyrus E. Brown has been made assistant contracting car and structural engineer of the Cambria company.

W. W. Rosser, manager of western sales of the T. H. Symington Company, Rochester, N. Y., has been appointed vice-president of the company, with office at Chicago.

The Pullman Co., at a directors' meeting recently held in New York, elected the following officers: Richmond Dean and Le Roy Kramer, vice-presidents; Clyde Reynolds, assistant to the president, vice Le Roy Kramer, promoted; L. S. Hungerford, general manager, vice Richmond Dean, promoted.

Henry R. Towne, for 46 years president of the Yale & Towne Manufacturing Co., New York, has been elected chairman of the board.

Walter C. Allen, vice-president and general manager of the Yale & Towne Manufacturing Co., has been elected president and general manager to succeed Henry R. Towne, who has been elected chairman of the board.

The annual meetings of the Cambria Steel Co. and of the Cambria Iron Co. were held at Philadelphia on March 16. The retiring directors of both companies were re-elected.

The Locomotive Pulverized Fuel Co. has been granted a charter in Delaware to manufacture patented fuel saving devices. The incorporators are Joel S. Coffin, Englewood, N. J.; John E. Muhlfield, Scarsdale, N. Y.; H. F. Ball and Samuel G. Allen, New York, and LeGrand Parish, Mountain View, N. J.

McCord & Co., manufacturers of railway appliances, have removed their general offices from the Railway Exchange building, Michigan avenue, Chicago, to the plant in West 120th street, West Pullman.

The Chicago office of the Terry Steam Turbine Co. is now located in the Peoples Gas building and is in charge of A. W. de Revere. An office has also been opened in the Michigan Trust building, A. L. Searles being in charge.

The National Positive Lock-Nut Co. has been incorporated in New York with $10,000 capital stock. M. Furitz, 1028 Fortieth street, Brooklyn, N. Y., is interested.

At the annual meeting of the National Railway Appliances Association, held on March 16, the following officers and directors were elected: President, Philip W. Moore, P. & M. Co., Chicago; vice-president, H. M. Sperry, General Railway Signal Co., Rochester, N. Y.; treasurer, C. W. Kelly, Kelly-Derby Co., Chicago; director, R. C. Jacobi, Johns-Manville Co., Chicago; director, R. C. McCloy, Wm. Wharton Co., Philadelphia. The directors holding over are E. H. Bell, the Railroad Supply Co., Chicago; J. Alexander Brown, Pocket List, New York; E. E. Hudson, Thos. Edison, Inc., Orange, N. J.; and M. J. Trees, Chicago Bridge & Iron Works. The treasurer's report showed a balance of $8,964.60 on hand, an increase of $746.57 over that of last year, all bills being paid. The board of directors held a meeting on March 18 and re-elected Bruce V. Crandall as secretary for another year.

George B. Serman, of Watertown, N. Y., has been made a director of the New York Air Brake Co., to succeed the late George B. Massey, of Watertown. The other directors were re-elected.

The Northern Chemical Engineering Laboratories, Madison, Wis., are now known as the C. F. Burgess Laboratories. The new name implies no change in management or ownership.

OBITUARY

Henry H. Sessions, vice-president of the Standard Coupler Co., died at his residence in Chicago, March 14, at the age of 68 years.

William T. Simpson, vice-president of the American Rolling Mill Company, Middletown, Ohio, died in Cincinnati on March 30. Mr. Simpson was born in Saratoga county, New York, and was 59 years of age.

Frederick A. Hall, formerly head of the chain hoist department of the Yale & Towne Co., died at his home in Passaic, N. J., on March 16.

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CONTENTS.

A Central Testing Plant

The final test of any method or device, of course, is the way it behaves in actual service, but this does not detract from the value of work done in the experimental or testing plant. Tests of this nature cull out the poorest methods and devices, and often result in many improvements being made to the original device before it is given practical service. Those roads which maintain well established testing plants are looked to as leaders. Materials and devices are not placed in service at once at a high expense but are tested with all possible accuracy and are compared with similar devices.

However efficient testing plants are expensive to maintain and only the very large systems can afford them. Even the large systems cannot maintain very elaborate plants. There are a great many tests which could be conducted at some central experimental testing plant and while the idea is not a new one by any means, it would seem that such a plant could do much good, especially if it was under the auspices of the mechanical associations. Possibly the most effective and economical method of running such a plant would be in connection with some technical school. This would not only cut down the expense but would allow it to do work of a broader scope.

Flue Cleaning on Superheaters

The flue cleaning question is always an important one, whether on a saturated or superheater engine, and sometimes the superheater is blamed, when its tubes are in a condition which would not be tolerated on a saturated engine. The superheater flues constitute a considerable percentage of the water heating surface in a locomotive equipped with a superheater however, and if they are stopped up not only the heating surface but the efficiency of the superheater is affected.

The thorough cleaning of boiler tubes is, of course, of vital importance and every mechanical man recognizes it, but in the effort to keep the engine in service this fact is sometimes lost sight of. The much abused roundhouse foreman is the man who knows whether the tubes are being cleaned and he can do a great deal in increasing the efficiency of the engine. He is sometimes blamed for a poor condition of the engine which he cannot help because his force and time are too limited to give more than a superficial cleaning.

Many difficulties have been overcome by the superheater people but one of their greatest troubles has been due to the lack of cleaning of superheater flues. Some mechanical officers have apparently been of the opinion in the past at least, that all they had to do to get greater efficiency was to install a superheater and forget all about it. Any device worth while must be given attention and this is especially true of the superheater which when once installed is a vital part of the boiler.

The value and efficiency of the superheater has been proven beyond a doubt but it must be given care and attention. It takes hard, conscientious work at frequent intervals.

If the tubes are allowed to get so bad that some of the units have to pulled out, it is frequently the case that they are sprung or distorted and the superheater will get the blame. The superheater deserves good care and if the roundhouse force is not large enough to give the tubes the proper care it should be increased. Of course periods of cleaning vary on different roads and are influenced by the grade of coal used. However, everything that can be said about keeping the ordinary boiler tube clean should go double for superheater tubes.

Atlantic City

In a month or so, the annual meetings of the two leading mechanical associations will take place at Atlantic City. That the reports and papers will be up to standard and will probably excel those of past years is taken for granted. As has been the case in past years some will go there to work, a few to play, but the majority will go to combine business with pleasure. Some will go there for the first time, others are among those who say, "I've been at these conventions for the last eighteen years."

There are two sides of the convention to which the newcomer cannot give too much time—the convention sessions and the supply exhibits. The sessions of the convention constitute his primary object in attending. From them he will learn what other men are doing and can see the possibilities and progress in his chosen line of work. A careful study of the exhibits will show him what those who are daily studying his needs are doing to improve the tools and equipment with which he has to do. The supply men each year gather an instructive and expensive exhibit, the like of which the railway mechanical man cannot find elsewhere. He owes it to himself as well as to the supply men to give this exhibit his best attention.

The man who gets the most out of the time spent at Atlantic City is the one who combines business with pleasure. Evidence of this is seen among the scattered groups chatting together on the boardwalk, on the pier before the sessions commence or in some booth after the sessions are over, to say nothing of the evening entertainments, etc. One of the big things which the newcomer to Atlantic City brings back is the remembrance of good fellowship and a broader acquaintance among the best bunch of people in the country.

Modernizing Shop Machines

Steady improvements are being made in shop tools. in shop methods, and in methods of planning and laying out shop plants. The shop which is laid out and built today according to the most advanced ideas, will within a year or two be outclassed by a still more modern plant. Its tools, which today may be the best that the market affords, will be lacking in a number of ways after a few years have passed. Those in charge of shop plants and shop machinery must be always on the alert to see that the equipment is made to keep pace with the times, as nearly as possible. It is easy for a shop to get into a rut and to do the same things in the same old way, day after day.

The makers of machine tools are constantly improving their products; sometimes by entirely new designs but more frequently by alterations, or attachments to existing designs. No shop of course can afford to throw out a machine tool which has many years of usefulness in it, but by carefully watching developments in design, changes or additions to the machines in use may be made at a cost which will be more than offset by the increased production.

The application of motor drives to shop tools of course has been possibly the most important development in modernizing shop machinery during the past few years. Interesting examples of recent work along these lines are given in an article on another page showing how a number of old machines at the Sacramento shops of the Western Pacific were equipped with multi-speed motors. In this case, the old machines were being placed in new shops and perhaps the necessity of modernizing them was brought out more forcibly. The work in question is very interesting and may point to possibilities at other shops.

The older shops often are a prolific field for work of this sort. At the main shops of one large system, work of this character has been carried on for over two years and is still being carried on. The work referred to also includes a complete rearrangement of the tool layout which will enable the work to be handled more economically. It is work of this sort that causes some very old shops to be ranked among the most efficient. Such shops are efficient because somewhere in the organization there is a man who is always on the alert to look into the latest machine designs and to ascertain if some shop tool cannot be modernized with economy.

Operating Results in Brief

The net operating income of the railways of the United States for January, 1915, decreased $5 per mile, or 2.8 per cent, as compared with January, 1914; in January, 1914, it was 25.6 per cent less than in January, 1913.

Total operating revenues amounted to $214,196,786, a decrease from 1914 of $17,006,859. Operating expenses were $163,769,221, a decrease of $16,307,796. Net operating revenue amounted to $50,427,565, a decrease of $699,063. Taxes amounted to $11,213,928, a decrease of $87. This left $39,174,218 for net operating income, the amount available for rentals, interest on bonds, appropriations for improvements and new construction, and dividends. Operating revenues per mile of line averaged $936, a decrease of 8.3 per cent; operating expenses per mile averaged $716, a decrease of 10.0 per cent; net operating revenue per mile averaged $220, a decrease of 2.4 per cent, while taxes per mile were $49, a decrease of 1.0 per cent. Net operating income per mile was $171, a decrease of 2.8 per cent. Railways operating 228.690 miles of line are covered by this summary, or about ninety per cent of the steam railway mileage in the United States.

THE CAR DOOR QUESTION.

By W. K. Carr, Genl. Car Ins., N. & W. Ry., Roanoke, Va.

The subject of outside hung doors and wood door stops is one that at present is not receiving the attention by railroad companies that is necessary or that should be given it.

Let us first consider the outside hung door on the older wood underframe cars, and be convinced that its original fastenings, etc., do not afford the protection to the door that they should have in the present day. Many of the doors have very poorly designed top hangers, and they are so made that it is next to impossible to open the door or close it. You have only to look at the bottom corners of the door and you will find same to be cut away, caused by the use of large iron bars at warehouses and sidings, in order to open and close the doors.

Again, the majority of these doors are provided with but two guide castings at the bottom; one located next to the wooden door stop at forward end of door, and the other at the rear end of door when closed. These two castings afford the only protection the door has to hold it in position when closed, provided the hasp has not been placed over the staple, or whatever means may be provided to engage the hasp in order to lock and seal the door. When the door is moved back sufficiently to pass the lower guide casting next to the door stop, there is then only one other casting provided to prevent the door from swinging outward, unless the door is pushed back entirely. Thus we find in some cases that a small casting is fastened on the belt rail of the car, which is intended to assist in holding the door in place so as to prevent it from swinging away from side of the car when passing trains on double track roads, or striking cars in yards when shifting, or in handling the cars. It frequently occurs that car inspectors are injured in yards due to these very conditions.

We find that the lower door rail and siding are cut away at the lower corners of door. These should be in condition to hold door in place, but, due to the worn and broken condition of rail and siding, the door can swing outward and is very dangerous to passing trains. Again, it is often the case that the top portion of these lower door castings is broken off, and when such is the case the door can and will swing outward. These are the conditions that are confronting one every day, both in the yards and on cars in transit. The cars are allowed to run, as owners do not repair them, and foreign lines do not have the proper door castings, resulting in conditions getting worse instead of better. The owners of cars so equipped can easily see these conditions and if they would start on their own cars a decided improvement would soon be noticed.

The expense in connection with the improvement would be very little, but it is very necessary that the owners take the initiative, as they are in possession of the repair parts. My suggestion would be to add two more bottom guide castings to each door, so as to have two castings holding the door close to side of car, in whatever position it may be, and to prevent any possibility of the door swinging outward when passing trains or being handled in the yards.

Next, the wooden door stop has also outlived its usefulness. We find that in very many cases the wood door stop is split, or possibly poorly secured to side of car. In case it is split it usually happens near the door fastening. In that case it is no hard matter for the car robber to remove the fastening and replace same without disturbing the seal. The result is when the car arrives at its destination, the contents check short and immediately a shortage claim is prevented. It also allows rain to beat in at forward end of door, as it is away from the stop and allows a space for rain and snow to blow in. The very many cars that are at present in service, and conditions as mentioned here justify the different railway companies owning same to take steps to improve the conditions.

We would suggest the immediate abandonment of any and all wooden door stops, and the use in its place of a metal bar of the "Z" pattern. There are two or three very good reasons why this should be done, namely, better protection to door when closed, perfect storm protection, no splitting or breaking, and better chance to secure the door fastenings.

THE MASTER MECHANIC'S OFFICE

By Louis Brentnall.

Efficiency in handling office work depends almost entirely upon two things, i. e., ability of the clerks, and the office appliances at their disposal in expediting rapid writing and figuring.

The first requisite in attaining efficiency in handling the master mechanic's office work is generally fulfilled by reason of the master mechanic's good judgment in selecting clerks specially adapted for handling mechanical department computations and records. Even good clerks in commercial lines feel like school boys in a shop office, where locomotive mileage, costs per mile run for supplies and repairs, and the computation of shops expenses, accounts chargeable, etc., are as foreign to them as railroading is to a storekeeper. "What railroad experience have you had?" is a question which has excluded inexperienced mechanical department clerks from working in the master mechanic's office. This has generally enabled the master mechanic to handle his office work at a good average efficiency, so far as the ability of hic clerks is concerned.

Ordinarily, a master mechanic's chief clerk is a man who has had some special mechanical department experience. He may have been clerk to a foreman, or perhaps he was a shopman or engineer with clerical ability, who sought office work on account of having lost a hand or a foot. At any rate, he is usually a man who has good mechanical department judgment, as well as clerical ability, for his duties require, at times, that he shall handle matters relating to the division in connection with his clerical work, especially during temporary absence of the master mechanic. The wrecking crew may be needed at an outside point, and in such a case there is no time to ask what should be done if the master mechanic is not within hearing. A chief clerk's efficiency, therefore, depends as much upon his railroad experience as upon his clerical ability—with a preference for his experience, should he not be "fine at figures." An ordinary clerk may work all day in compiling figures, a review of which by a practical chief clerk may bring the comment, "Your figures are wrong!" His practical judgment enables him to discern errors and irregularities. Being a chief, he is, of course, more than a clerk.

Some master mechanics allow their chief clerks to select the clerks for handling the routine office work, such as timekeeping, shop distribution, compilation of statements, handling of reports and keeping records, while other master mechanics prefer to at least see new clerks before they are put at work. Of course, in some respects it is immaterial who does the hiring, so long as the clerks are of the right kind, and most chief clerks are able judges of clerical ability.

Good stenographers, however, are sometimes "rare birds." The trouble with most of them is that they do not grasp the meaning of the dictations on account of the technicality of mechanical department terms. "You do not seem to get it as I said it," is a common complaint

in this connection, sometimes on account of the stenographer missing reading his notes, but more generally by reason of his not interpreting the meaning of what was said. Usually, the best stenographer for the master mechanic's office is one who has worked in a foreman's office, or who has at least had previous railroad experience. A low wage, of course, may deter getting a thoroughly experienced man, but if he is familiar with mechanical department terms he may do better than a high-priced stenographer.

Expediting office work by using up-to-date office appliances is a feature which has not yet reached some of the smaller railroad offices. There was a time when adding machines, duplicating machines, dictation phonographs, etc., were considered too expensive for even large railroad offices, but when it comes to handling office work efficiently, these appliances must be given consideration, and no doubt more master mechanics' offices will be provided with such equipment in the future than has been considered advisable in the past, for computations can be handled much quicker on an adding, multiplying and dividing machine than can be done mentally, and generally with a greater degree of accuracy.

Computing tables also facilitate rapid calculations, while systematizing the rendition of reports and the compilation of statements adds to the efficiency of the master mechanic's office.

THE BLACKSMITH AND THE SCRAP HEAP.

By H. H. Jones, Sierra Ry., Jamestown, Cal.

A great many master mechanics in railroad circles have thousands of dollars in so-called scrap piles, waiting for some one to pick them up. I don't expect my suggestions will be of material benefit to large and up-to-date shops, but believe they will assist the managements of the small and middle class shops in cutting down their storeroom expenses.

We will take first "old tire" that is so often allowed to pile up and rust away, when it contains thousands of pounds of good steel. In shops that have the steam hammer, various articles can be made to advantage out of this steel. Take first the making of "pinch bars." Nick the tire twice in the inside with a cold chisel and sledge, the cuts being opposite each other. Place a heavy jack inside the tire, only opposite from the cuts, tighten it up until a heavy strain is placed on the tire and strike a blow over each cut outside the tire. The tire will then break at both cuts. Then nick to the proper length and break cold under the hammer, draw the pieces down to 2½ sq. in. and heat either in a furnace or hollow fire. You will then be able to hold the piece secure while drawing down the handle, which can be done in one heat with a 1,200-lb. hammer. The other end can be forged by hand or a tool made on the same lines as a hammer swage and forged in two heats. Bars made out of tire have proven good bars, being tough, hard, and will not break or bend. Draw the color or temper to a pale blue.

The tire can also be drawn down to 1½ in. x 1 in. and used for pick steel, thus saving another steel bill. We do this in our shop and consider it quite a saving, as the picks require no tempering and the pieces cut off to the proper length can be welded under a belt hammer, with a simple lap weld and finished in one heat.

Various tools can be made out of tire steel, such as big sledges, tamping bars for the track, dies of all kinds requiring a hard steel, hot cutters for the hammer, etc. We made a set of dies for our hammer 16 in. x 6 in. x 6 in., using axle core for the bottom that is planed out to fit in the die block. The tire was then welded on the top of the iron and planed all over. These dies have been in constant use for nearly three years and are still in good shape, being hard enough not to require tempering and soft enough to plane when necessary.

Let us go to the scrap pile and gather up the old coil springs and make "jack levers," "buggy bars," platform bars and drift pins for the rip track. The flat spring steel will make your rip track wrenches if you need any, and when you are repairing your old locomotive springs don't take the new steel from the rack for your short leaves, when the scrap bin is full of steel.

When you see your blacksmith take a new bar of iron out of the rack, see if you do not remember that piece of iron laying out alongside the roundhouse that is just right for that job he is doing. How about those old pilots that have been discarded? You might just as well have the roustabout gang knock them to pieces; there's about 12 ft. of 3 in. x ½ in. iron in them and the wood sawed up will fire up your sand house or do for some station agent along the line. Don't overlook that pile of tie plates that have been accumulating on account of being straightened—the steam hammer and a man will clean that up for you quick. Those old spikes, too, if straightened up, will be O. K. to use in the yards and side tracks. One man can straighten 4 kegs a day.

Cut up all of those old scrap rails for brake beams, for they make fine beams. You may also have a pile of 4¼ in. x 8 in. worn-out axles. They will make good 4 in. x 7 in. axles. Have the blacksmith jump a piece of 4 in. x 1 in. "scrap material" against the end and use the ram, driving the whole end back in a nice ball. Then take a mellow welding heat on it, working it down to the proper size, and you are an axle ahead. Or, take the 4 in. x 7 in. axle that is worn out, forge a collar (out of scrap axle iron) 6½ in. x 1¼ in., weld on the worn-out journal under the hammer in a V-block, and the machinist can do the rest. Will it pay? Well, you have just a certain number of men to run your small shop; you cannot lay off any, so if you get these jobs done while the men are resting rainy days, don't you think you are ahead?

Recreation Facilities for Employes

The Grand Trunk Railway has for many years done a most practical kind of welfare work for engine and trainmen through the Railway Y. M. C. A. Buildings have been erected at fourteen division points, which provide meals, beds, baths, recreation, books, magazines, etc.

The company makes a monthly appropriation of from $90.00 to $150.00 per month to these associations, making a total sum of about $1,500.00 per year in addition to first cost of the buildings.

The employes contribute to the support of these associations by a small annual fee for membership, and by paying cost price for meals and lodging. Clean beds are given for the modest fee of 15 cents, and meals at about 30 cents.

This type of work was inaugurated on the Grand Trunk fifteen years ago by the late Chas. M. Hays, and has been continued and extended by his successor, E. J. Chamberlin.

The popularity of this movement is shown by the fact at New Toronto freight yards the building has been enlarged five times. Co-operation is the motto of the Railway Y. M. C. A., the management of the local association being in the hands of a committee made up largely of the employes who use the privileges. This sharing in the management disarms suspicion, and makes clear to all that the returns to the company are indirect, being only through the improved physical and moral condition of those who spend their time, when off duty, in a wholesome atmosphere.

Applying Motor Drives to Old Machines

How a Number of Belt Driven Machines at the Sacramento Cal., Shops of the Western Pacific Were Equipped with Motors

By W. E. Johnston, Chief Draftsman, Western Pacific Ry., Sacramento, Cal.

When we built the new shops of the Western Pacific at Sacramento, Cal., we had several old machines which had been driven by belts, but which were otherwise good tools and suitable for the new shops. It occurred to me that multi-speed induction motors might be adapted and I arranged therefore for the purchase of several for use on the old machines in order to convert them into individual motor driven machines. The results of this plan have been even better than I expected.

The application of alternating current motors to old machine tools equipped with cone pulleys has always been a matter of some difficulty for the reason that squirrel cage motors of the standard types operate at only one practically constant speed, and the motors with wound rotors also tend to approach synchronous speed when running light. The multi-speed motors which have now been made commercially successful for 3-phase current furnish a convenient solution of the difficulty, as they can be had with synchronous speeds of 1,800, 1,200, 900 and 600 R. P. M., the four different speeds in one motor being obtained by varying the number of poles by means of a drum controller.

For shops where only 2-phase current is available it is necessary to transform the current from 2-phase to 3-phase, which may be done very conveniently by means of two transformers. Any number of the multi-speed motors may be operated from a pair of transformers of current delivering capacity equal to the maximum demand of the motors. The motors have good operating characteristics, with the exception of a rather low power factor at light loads and low speeds, and give quite as satisfactory service as the ordinary motors.

The application of one of these multi-speed motors of 6 H. P. capacity to an old 36"x33' 0" engine lathe originally equipped with a cone pulley is shown in Fig. 1. The cone pulley was removed entirely and replaced by a sleeve carrying the gear driven by the motor pinion. This was the only change made in the machine itself, as the back gears and triple gears gave satisfactory spindle speeds as originally arranged. The no-load spindle speeds obtainable are as follows:

Motor speed.	Direct.	Back geared.	Triple geared.
18,000	300	42	7.7
1,200	200	28	5.1
900	150	21	3.8
600	100	14	2.5

The full load speeds are about 5 per cent lower.

As shown by the drawing, the motor is controlled from the apron by a hand-wheel, which operates the controller by means of a splined shaft extending the full length of the bed. With this arrangement all four motor speeds in both directions are instantly available to the operator without it being necessary for him to move away from the carriage, and the handling of the work is correspond-

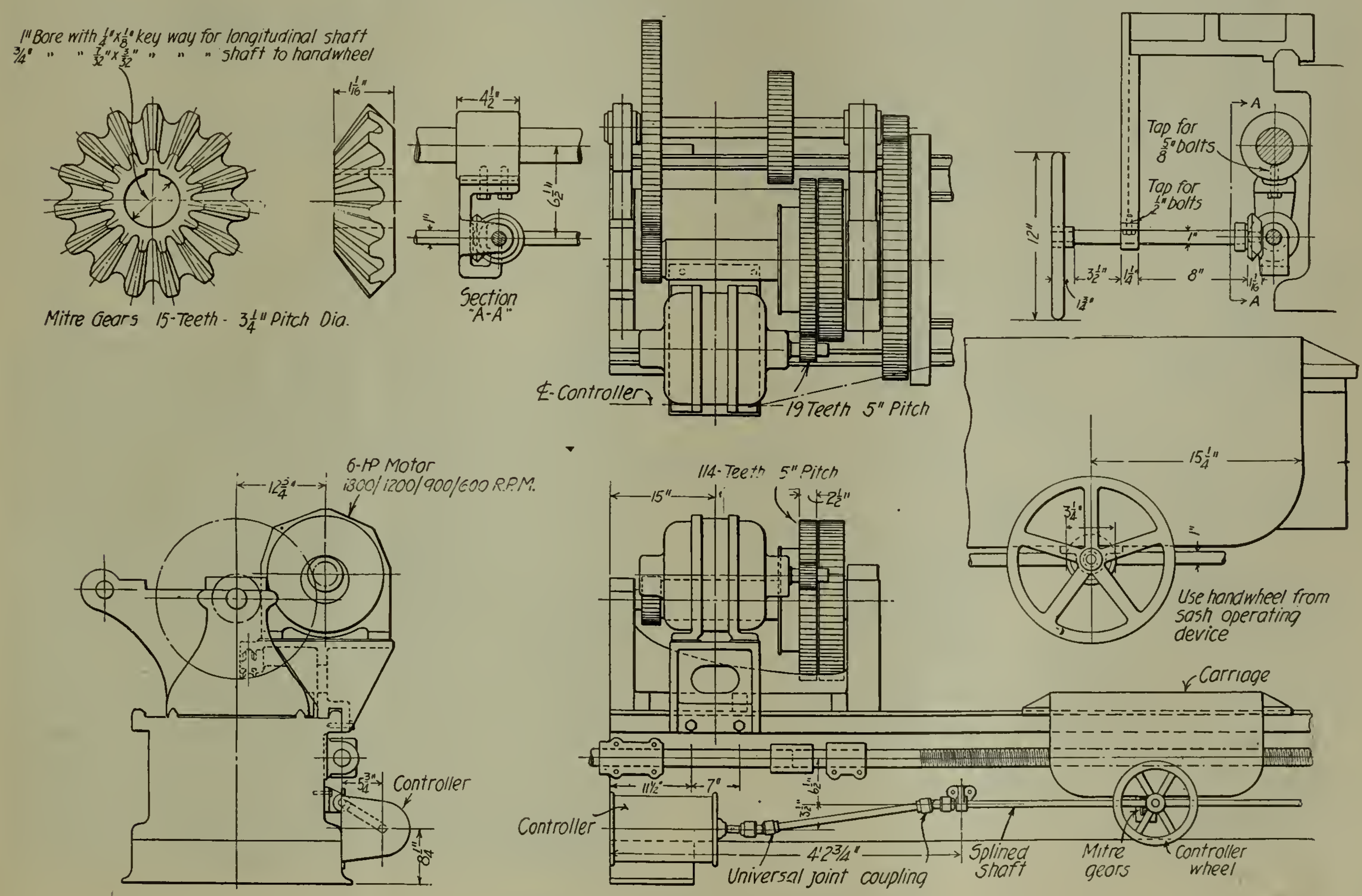


Fig. 1—Application of Multi-Speed Motor to Lathe.

Fig. 2—Multi-Speed Motor Applied to Radial Drill Press.

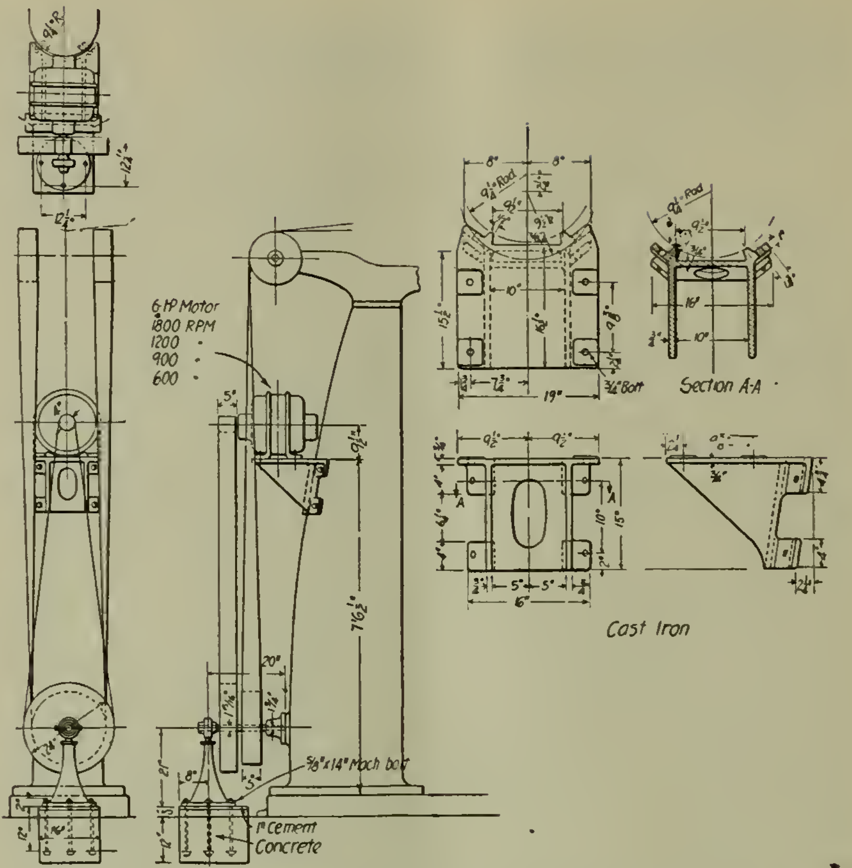


Fig. 3—Multi-Speed Motor Applied to Radial Drill Press.

ingly rapid. This is especially convenient in setting up long work.

The application of another 6 H. P. multi-speed motor to a large radial drill press is shown in the photograph, Fig. 2, and the drawing, Fig. 3. This machine was originally equipped with a cone pulley at the base of the column. This was removed and a single pulley was applied for the belt from the motor. The original back gear had a ratio of 12.1, which would have left too large a gap between the direct and back geared speeds with the multi-speed motor whose maximum speed was three times the minimum. One pair of the gears was, therefore, removed and a new pair substituted, giving a ratio

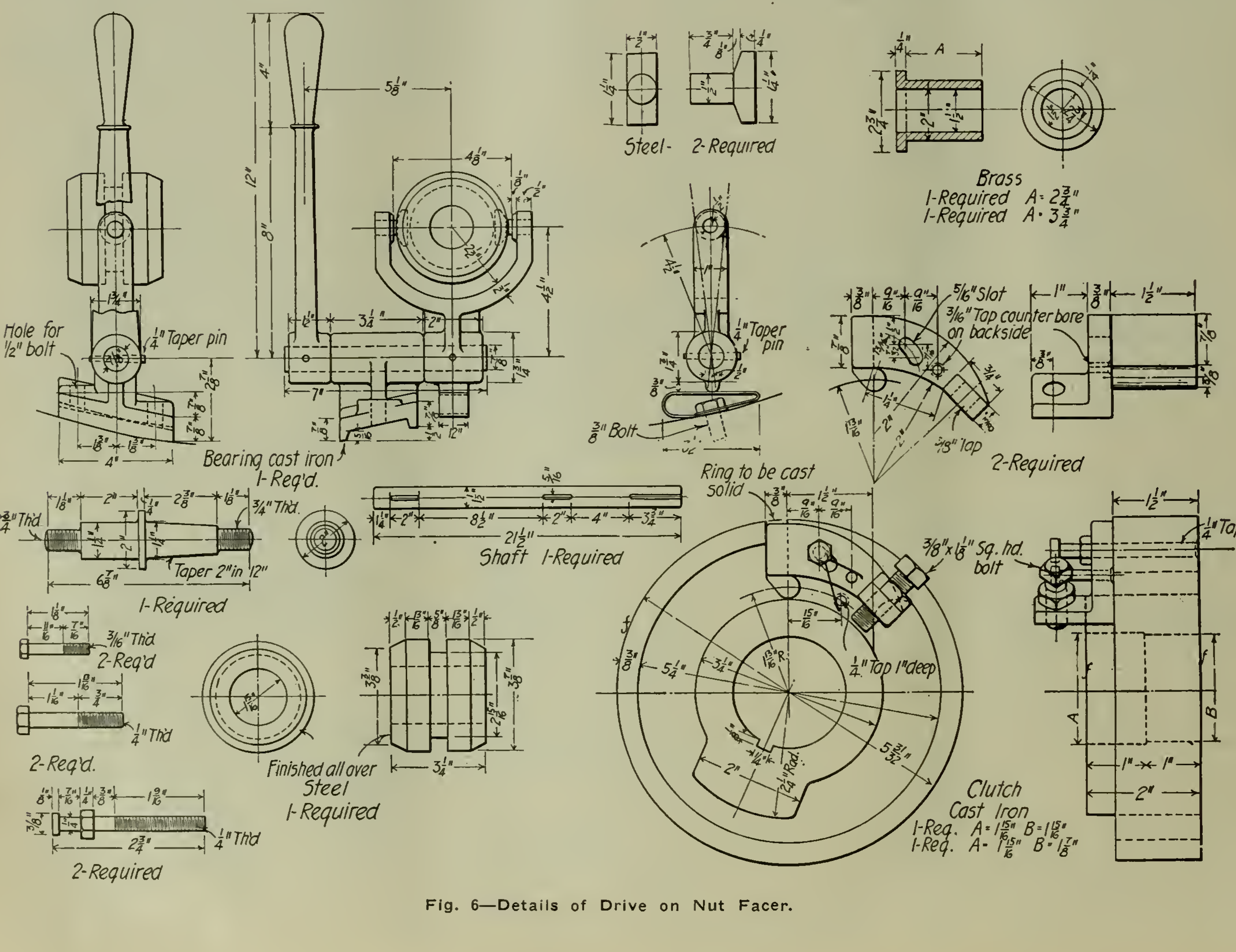


Fig. 6—Details of Drive on Nut Facer.

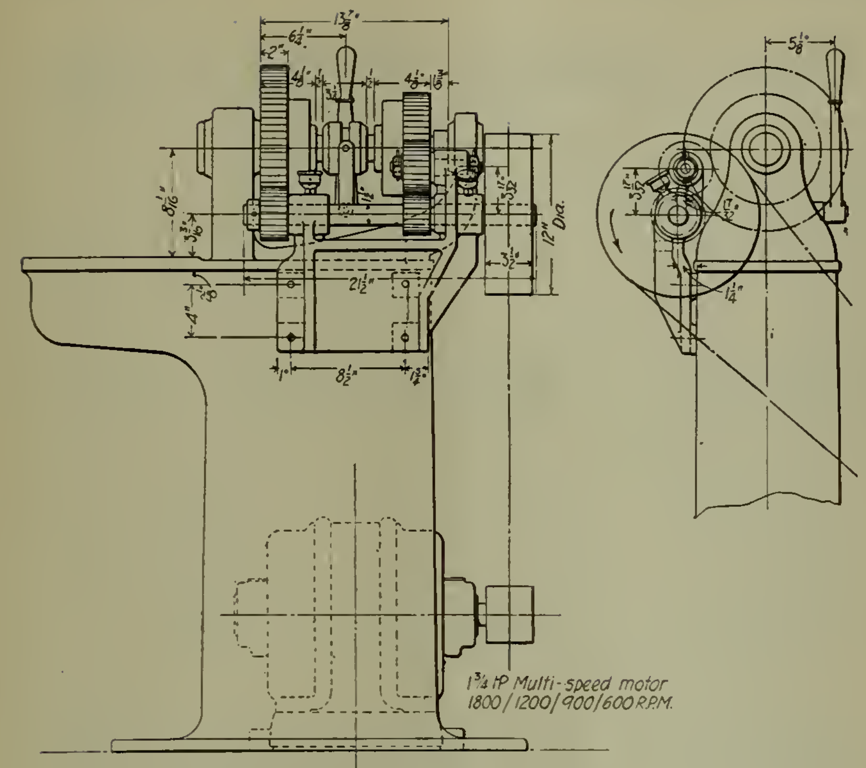


Fig. 5—Application of a 1¾ H. P. Motor to Nut Facer.

of 4½.1. This gave the following spindle speeds, which have proven entirely satisfactory:

Motor speed. R. P. M.	Direct. R. P. M.	Back geared. R. P. M.
1,800	210	47
1,200	140	31
900	105	23
600	70	15

The controller on this machine, as shown by the photograph, is mounted in an inverted position directly on the head. With this arrangement the entire range of speeds is available without the operator moving away from the head. In order to convey the current from the line to the controller and from the controller to the motor it was necessary to make up a special cable, using extra flexible stranded wire held together by a braided covering of marline. This cable is led first to the vertical sliding support for the arm and thence to the head, the cable being of sufficient length to permit the arm and head to be moved to any position within their range without any change in the connections.

Fig. 4 shows the application of a 4 H. P. multi-speed motor to a crank planer. This motor was applied by the machine builders and was preferred to a gear box by the railroad company. In this case the controller could be advantageously mounted directly in front of the motor, giving a convenient arrangement for the operator and making the wiring very simple. The controller on this machine is blocked so that the machine can be operated in only one direction.

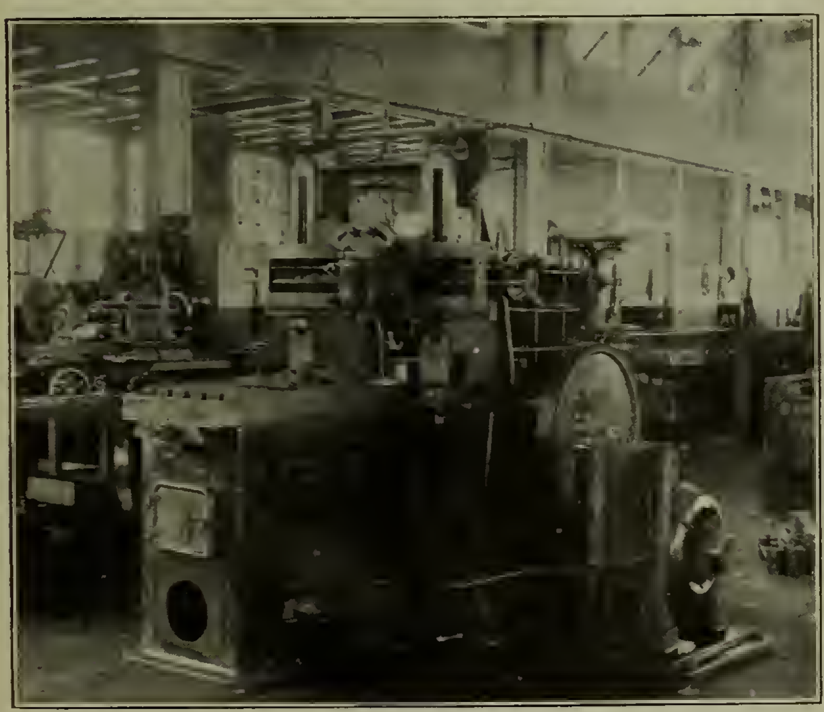


Fig. 4—Four H. P. Motor Applied to Crank Planer.

The drawing, Fig. 5, shows the application of a 1¾ H. P. multi-speed motor to an old nut facer. On this machine it was desired to reverse quickly to run the nuts off the spindle after they were faced. This was accomplished by using the double throw friction clutches, of which the details are shown in Fig. 6. The four direct speeds given by the motor were considered sufficient on account of the limited range in diameter of the work.

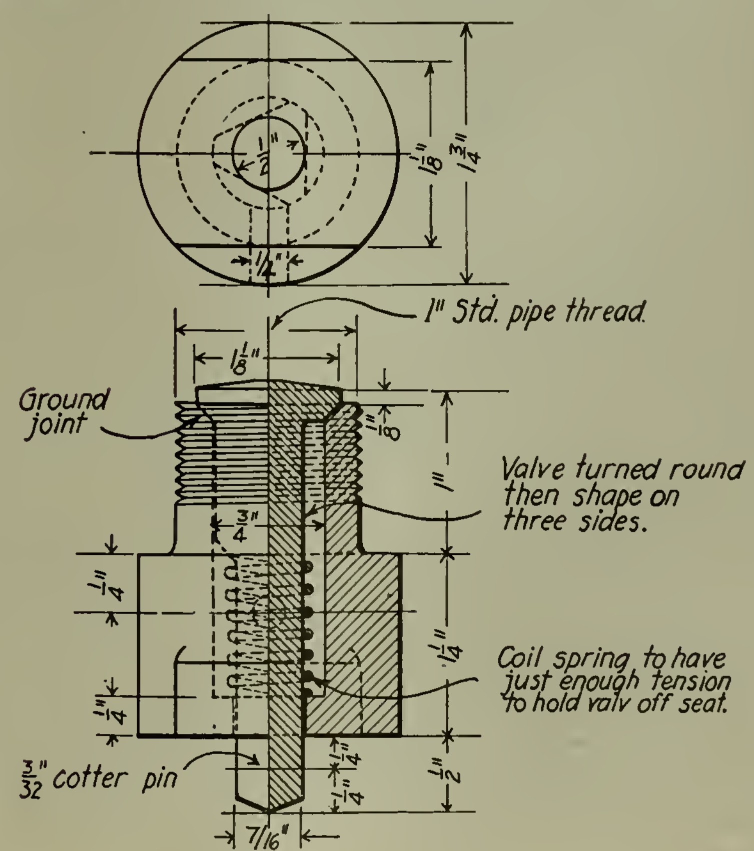
In the wood mill multi-speed motors have a special field for driving circular-cut-off and rip sawing machines on which saws of different sizes are used, and also for circular rip sawing machines on which dado heads are used. These machines usually have constant speed drives which can be made correct for only one size of saw. With the four speed motors, saws of any desired size within the range of the machines may be used and an approximation to the correct speed obtained by setting the handle of the drum controller at the proper notch.

The starting apparatus for the smaller sizes of these motors consists of the drum controller only. For 15 H. P. sizes and larger compensators with overload relays and no voltage releases should be used in addition to the controllers. On these larger motors the drum controllers are set at the desired speeds while the motors are at rest, and the starting and stopping handled by the compensators in the usual way.

AUTOMATIC CYLINDER COCK

By H. C. Spicer, Fmn., A. C. L. Ry., Waycross, Ga.

The automatic cylinder cock shown herewith is very economical and inexpensive. The valve body is made from a brass casting and the valve is made of wrought iron or brass, whichever is preferred, thus doing away with the other expensive devices commonly used on locomotives. This valve is especially suitable for yard service engines, as with its length of 2¼ inches overall it would not be knocked off so often on places where obstructions were piled close to the tracks.



Automatic Cylinder Cock.

Fuel Economy in Railroad Service*

An Analysis of Seven General Factors Which Influence the Fuel Consumption of Locomotives, and Some Deductions Therefrom

By M. C. M. Hatch, Supt. Fuel Ser., D., L. & W. R. R.

"Economy" and "Efficiency" are, at present, about the most popular words in railroad diction, looked upon as pass-words to the province of 20th century operation; as powerful in their way as was the "Open Sesame" of Ali Baba. To realize their full force, however, they must be combined, the somewhat unwieldy result of "Economical Efficiency" being obtained. Illustrative of what their combination means: You are talking fuel with a locomotive fireman and you say, "Now the first thing you want is steam (efficiency) and you want to get that steam with the least posible fuel" (economical efficiency). "Efficiency," strictly interpreted, does not go back of *results;* "Economy" may be carried so far as to overlook, in a measure, *results;* hence the need of the combination of the two, to convey a proper indication of what the railroads of this country are trying to accomplish along their ramified lines of endeavor. Consideration of this has caused the writer to coin the word "ecofficiency" as covering the entire situation in itself.

What is the problem involved in locomotive fuel ecofficiency? Simply that of obtaining, at the draw-bar of the locomotive, a work equivalent of all the heat units present in the fuel consumed in the fire-box. There are losses, fundamental in character, which preclude the possibility of the attainment of this 100 per cent performance, but it is, like infinity in mathematics, the limit towards which our endeavors should be directed. Other losses there are which are "attackable" and which will justify such attack as yielding dividends, in results, commensurate with the time and money spent against them. Let us analyze the situation as carefully as may be, to determine along what lines our endeavors in this field should lead us.

During the year ending June 30, 1913, there was expended for fuel supply on American railroads the sum of $241,598,314.00, this amount being 11.4 per cent of the total operating expense. The tonnage equivalent was, approximately, 130,000,000 tons—truly an enormous amount. As an "ocular" demonstration of what this tonnage means, consider that the Boston & Maine has 2,300 miles of track. A pile of this length and with a triangular cross section 40 feet at the base and 20 feet high would contain about the amount of coal purchased for the locomotives in this country yearly, and a train of 80,000 pounds capacity steel hopper cars, which would girdle the globe at the equator, would be needed to move this tonnage. A generally accepted figure of 20 per cent is allowed for stand-by losses on road, in engine house, en route from cars and tenders, waste at pops, etc. Assuming that this is correct, we have then 80 per cent of the total, amounting in value to $193,000,000.00 being put through our locomotives yearly, while doing useful work. The thermal efficiency of the modern locomotive is in the vicinity of 5.5 per cent so that, if fully utilized, our 100 per cent condition, the cost of fuel for doing the present work calling for nearly two hundred millions would be about $11,000,000, the tremendous difference being made up of wastes, both avoidable and unavoidable, which do not, actively, move a ton of freight or a passenger. A heat balance will show about where these losses, in so far as the boiler is concerned, occur and, from analyses of recent tests on modern power, the following balance has been made:

Loss By	Equivalent To	
Combustible present in ash........	6.00%	
C O............................	1.20%	
Sparks and Cinders..............	6.30%	
Heat rejected at stack............	13.00%	
Radiation and unaccounted for....	11.00%	
Total loss		37.50%
Utilized by boiler and superheater...		62.50%

The modern locomotive steam generating plant, then, transfers to the water or steam 62.5 per cent of the heat liberated from the fuel in the fire-box. Between the boiler and the application of the power, *i.e.* the rail, there are other losses of great magnitude, which reduce the over-all performance to the comparatively small figure of 5.5 per cent mentioned above. Of these losses the most important, as well as the most difficult of reduction is that of heat rejected from the engine cylinders at the exhaust. With all steam engines, but especially with those of single expansion, non-condensing design, this thermal waste occurs and would hardly appear to be susceptible of much reduction. Friction at the cylinders, rods, journals, rail, etc., also reduces the available work, and while this is not a thermal loss it still cuts down the over-all performance of the power plant.

We may state, under seven general heads, the factors which exercise control over the fuel consumption of locomotives—these are:

A—Design,
B—Maintenance,
C—Engine House attention,
D—Fuel,
E—Operating Department,
F—Engineers,
G—Firemen,

and they may be analyzed as follows:

A—DESIGN.

In attacking the design of a locomotive there are certain known factors, such as limiting wheel loads, right-of-way clearances, topography of road, class of service, desired power to be developed at the draw-bar, and in connection with wheel loads and power, wheel arrangement, upon which to build, as a foundation. In the first survey of the problem we will, bearing in mind the above, be able to determine wheel and cylinder size and boiler pressure. From these the maximum horse power output of the engine, reached at from 700 (saturated) to 1000 (superheated) feet per minute piston speed becomes known. The boiler, "lungs" of the power plant on wheels, should supply steam sufficient to hold the engines up to this horse-power delivery, if most satisfactory results are to be obtained. Boilers of this 100 per cent capacity, and even considerably more powerful, are now the rule, their use generally necessitating the employment of trailng wheels in order to allow for a fire-box of sufficient size. From the steam delivery desired we may determine the boiler heating-surface needed to evaporate the necessary water, and from this we come to grate

* A paper read before the New England Railroad Club.

area which must be so proportioned, with regard to the heating surface, as to provide for consistent fuel rates when the boiler is working to capacity. The fire-box volume must be ample, to allow proper mixing and burning of hydro-carbon gases, evolved from the combustion of all fuels, but especially the volatile bituminous coals. The use of combustion-chambers in large power boilers would seem to be advantageous, increasing fire-box heating surface and volume, and shortening what might otherwise be excessive tube length. Very long tubes of small size, while increasing the total heating surface, will so much increase gas friction as to impair the over-all efficiency of the design, in other words, setting up a greater difference in draft head between the tube sheets than is consistent with good practice. A ratio, length divided by inside diameter, of 110 to 1, would, from present information, seem to be as far as we should go and a reduction to 100 to 1 may prove, in service, to be more satisfactory. Further than these, good design must include good depth of throat, consistent tube spacing, water-leg design to give all possible freedom to circulation, ample steam space, convenient clean-out facilities and first-class workmanship.

If we follow along these lines the result will be an ecofficient boiler which will give the necessary steam output without excessive fuel rate; will, therefore, not show too alarming spark losses (these being a function of fuel rate); will not require abnormal draft action in the front end in order to maintain good combustion; will not suffer from restricted circulation areas around its tubes or fire-box sheets; will not tend to prime, and will be satisfactory to operate as it will steam without undue forcing.

The engines now merit consideration. As stated above, the class of service and topography of the road will enable us to fix the wheel size and from this, knowing the desired tractive force, the cylinder power can be determined. The design of the cylinder as regards clearance volume and ratio of stroke to bore will affect the water rate and, hence, the coal pile. Piston speed should not exceed 1,500 feet per minute at the calculated maximum speed, equivalent to diameter of wheel in inches. The valve motion must be positive, rigid, protected from wear by bushings and hardened pins, easy of inspection and lubrication, non-adjustable, as light as consistent with strength and must impart to the valve the motion desired. The valve itself, probably piston, may be, especially with superheated steam, of small diameter. One important road is now using a 12″ valve in all classes of power and this, if extraordinary trouble is not experienced with the valve rings, would seem to be a step in the right direction. A small valve means a light valve and a light valve means much reduced stress on the valve motion, especially at high speed. The valve should be set so as to give as constant turning moment as possible. At high speeds the compression should not be allowed to run too high at working cut-off, as excessive compression imposes additional work on the engines and is also detrimental to machinery. Port opening and closing should be ample, positive and rapid to reduce wire-drawing to its lowest terms. "Tail-rods" may be used to advantage with cylinders of 23″ diameter and over, helping as they do, to reduce cylinder and packing ring wear and, therefore, blows. The internal friction of the entire mechanism, can, by judicious choice of material, dimensions and design be made relatively small, thus increasing the machine efficiency. Ample means of lubrication is a prime necessity, especially at cylinders and journals.

The "front-end" is merely a vacuum pump, whose duty it is to draw air for combustion through the fire and products of this combustion over and through the heating surfaces to be discharged, at as low a temperature as possible into the atmosphere. This pump has for its source of power the exhaust jet from the cylinders. Now, the value of any mechanical device is measured by the ratio of work done to power supplied, which law being applied to the front-end, means that it should develop the needed vacuum at the front tube sheet (back of this, boiler design governs) with the least possible back pressure on the engine pistons. To arrive at this result, the gas friction within the front-end itself must be reduced to a minimum by providing a well-designed stack, ample netting areas, unrestricted gas passages and by eliminating, so far as possible, abrupt changes in direction of gas flow. The mechanical strength of the design should, also, be considered, in order to guard against high temperature, abrasion and violent motion. The ordinary type of front-end consumes much power in doing its work. In a paper before the International Railway Fuel Association at the 1912 convention, H. B. McFarland, of the Atchison, Topeka & Santa Fe, showed some startling figures on back-pressure horse-power found during a very comprehensive series of tests covering this subject. As example of this, a 25″ x 28″ Pacific, with 73″ wheels and 200 pounds of steam indicated at 50 miles per hour, 350 back-pressure horse-power, while a 24″ x 32″ Consolidated, with 57″ wheels and 180 pounds of steam gave, at 25 miles per hour, 260 back-pressure horse-power. Other engines ran to higher figures than these, one large Mallet indicating 1,025 back-pressure horse-power at 25 miles per hour. These all go to show that there is a very serious loss of power by the use of the ordinary front-end and experiments are now being made with induced fan draft in the attempt to relieve the cylinders of this large amount of negative work.

The grates should have as large percentage of air openings as can be obtained without loss of fuel through them. They should shake easily and lock level and securely. They should be well fitted to their bearers and these again to the sheets to preclude the loss of fuel at these points. Dump grates are often advantageous but, when employed, should be placed at the back of box to make impossible an influx of cold air against the flue sheet, when used on the road.

Ample air inlet openings under the fire are a prime necessity. The desideratum here is atmospheric pressure in the pan at all times, but this condition can hardly be reached in practice, although experiments have been made in which, by the use of funnels as air intakes, a plenum was attained in the pan while engine was in motion. Tests however, show that if, with the ordinary pan, 14 per cent of the grate area be allowed for air inlet area, with bituminous coal and 8 per cent with anthracite, further increases of area, within reasonable limits, will have very little effect on the ash-pan draft. With bituminous burning switching engines it may be best to reduce the 14 per cent allowance somewhat, in order to prevent too much waste of steam through the safety-valves, but in general the figures given will be found to give satisfaction.

The ecoficient locomotive should have a high-degree superheater to reduce water rate and hence, fuel consumption; a brick arch to improve combustion, increase value of fire-box heating surface, assist circulation by means of the arch tubes and protect flues; a power operated fire-door to relieve the fireman of unnecessary work and to encourage him in light and frequent firing; some means of handling the valve motion other than the time honored lever so that the engineer may work his engine to the best advantage without fear of his life; good "water-works" so that the man is not tempted to carry too much in the boiler for insurance against injector trouble. The feed-water heater may in time be developed

to the dignity of a practical device for locomotives. From stationary practice we learn to anticipate a fuel saving of 1 per cent for every 11 degrees the feed is raised in temperature by heat that would otherwise be wasted. Cab decks and aprons should be designed with a view towards eliminating fuel losses from the engine when in service. A general cab arrangement, convenient and safe for the crew will also certainly influence the operation of the locomotive for the better.

This paper seems to have been tending towards a homily on locomotive design, but the intention is to impress the fact that good fuel performance cannot be expected from power built without careful consideration of all the fundamentals above mentioned.

B—MAINTENANCE.

The ecoficiently designed locomotive is now in service and capable of giving the very best operating results, and we may look for such results only just so long as maintenance is followed up and the machine kept, practically in its original condition. This means proper back-shop and engine-house shop facilities, the latter being very important. The road which has a large first-class main shop, but is deficient in means for taking care of the necessary running repairs at its engine houses will find its unit locomotive repair cost higher as the engines go through for "general," than will one whose main shop is perhaps not so elaborate but which is better organized at engine division points to keep the day-to-day repairs caught up. The importance of proper reports from enginemen is great. The bald and unadorned statement "engine blowing," appearing on the book is not great encouragement for the overworked engine house foreman to start on a tour of exploration through cylinders, main valves and by-pass valves. The report should state, fully and definitely what is wrong and should be made out, without fail, immediately on reaching the house. One of the most satisfactory ways to handle this matter is to have a clerk to whom the engineer, as soon as he has registered in, dictates his list of troubles, which are reread to him, or by him, and signed. The defects so reported are transcribed by the clerk onto slips which are taken in charge by the foreman and the work apportioned out as usual. Every endeavor should be made to do the repairs before engines again go out, the spirit of "Well, I guess she'll hold together for another trip," being an expensive one and productive of engine failures. If our engines are to go over the road at a reasonable cost the boilers must be tight and cylinders and valve packing immune from blows. A bad cylinder blow will burn about as much coal unnecessarily as any other one thing that can be mentioned. The boiler fronts must be tight as must the steam and exhaust pipes in front end. Valve motion irregularities, grate work in need of repairs, engine out of tram, hard riding engines and tanks, etc., all exert a deleterious effect on our precious coal pile and should be suppressed as soon as found. The drafting should be carefully done to ensure the burning of an even, level fire. The tendency, when engine is turned in as "not steaming" is to, at once, reduce the nozzle size. This should, especially if steam has been made satisfactorily with the original nozzle, be however, the last resort as we are at once imposing additional work, through the medium of increased back pressure, on the engines when the exhaust area is reduced. In general, it is not good practice to bridge or split a nozzle when reduction in area is desired but the Pennsylvania Railroad is experimenting with a circular nozzle, having four short projections of triangular cross-section spaced 90 degrees apart and the results obtained are said to be most satisfactory.

C—ENGINE HOUSE ATTENTION.

The treatment of locomotives at terminals, aside from repairs is important. When fires are cleaned the men must be taught to waste as little live fire as possible to the ashpit; blower must not be used harder than is necessary to keep the smoke and gas out of the men's faces and the pump should be shut off to keep the ashes and dust out of the air end and also to save the flues from cold air, which the pump exhaust will draw through them. If engine is to stand in house for a period of 36 hours or more it will, generally, be cheaper to dump the fire on its arrival than to hold under steam. If engines are kept under steam, however, the fires should be bright and alive next the tube sheet but with the back end pushed ahead and the back section of grates bare. With this method the fire doors may be kept shut, not allowing smoke to fill the cab, and the engines will stand for a long time without attention, never gaining steam enough to open the pop but holding plenty to work the injectors, move the engine at short notice or for any other practical purpose. Another good point of this method of holding fires is that, when it is being prepared for service, the back half is practically clean, as coked coal from the front of the box is merely pulled back to cover the grates which have been bare. Fire building is a point where saving can often be realized if a careful analysis of the situation is made. Flue blowing must be followed up and pains taken to see that the work is done properly. Tanks must not be overloaded at coal chutes as the lump of coal which falls overboard on the road and hits the poor, but honest track man on the head is of little value as a means of keeping the wheels turning.

D—FUEL.

In this part of the country when we say "Fuel," we mean "Coal." The kind we use will be very largely governed by the territory we are in. The New England roads must import their entire supply and the matter of transportation rates influences largely the locality and hence the kind of coal purchased. Other roads, differently situated, may have little or no concern with this phase of the problem; for instance, the Lackawanna gets its entire passenger engine supply from a point on its main line, of fairly central location. This fuel, anthracite, would be prohibitive in cost on a New England road.

Bituminous coal should, no matter where obtained, be required to run of uniform quality; it should be low in ash and sulphur, of a medium volatile content and, when run-of-mine as is generally the case, not over 50 per cent in slack. It may pay, under some conditions to buy screened coal, but generally run-of-mine will be satisfactory. It would seem that the ideal way to purchase coal would be under specifications, but few, if any, roads follow this practice. A run-of-mine specification could, however, be drawn up on an ash, sulphur and slack basis which would not be oppressive to the operator and would yet safeguard the consumer's interest satisfactorily. We buy about everything from corn brooms to locomotives on specifications, rigid and unchangeable, but our coal, so long as it is black, generally goes unchallenged for we have nothing definite to challenge on. The department making the purchase should, especially when lacking specifications, consult with the mechanical department as to the fuel best suited for its needs and which it is consistent to procure. One further point in this connection is that of check-weighing of supply coal as received, comparing actual scale weights with the bill weight, from which they will be found, sometimes to differ materially. A lengthy dissertation on this subheading is not of any very particular value, however, as we must generally burn what we get.

E—OPERATING DEPARTMENT.

The train operation of a railroad influences the coal consumption very materially. To merely mention certain points, overloaded trains requiring excessive length of time between terminals and unreasonable working of engine; poorly made meets and passing orders, necessitating long delays en route; failing to give inferior trains all possible time ahead of delayed superior trains; failing to pay due respect to the topography of the road when laying out regular train schedules; failing to scheme meets to bring them at the most advantageous points regarding profile; stopping trains unnecessarily for orders or any other reason; calling engines unreasonably long before they will be needed; calling helper engines when not needed and neglecting to call them when they should be used; locating water plugs without due regard to road conditions; all these and more eat into the coal pile and can, generally, be classed as unnecessary wastes. The practice of having dispatchers put in a trip or two monthly over the road, riding drag freights and other trains which are apt to be unduly long en route would seem to be a very good one as in no other way can such a clear idea of actual conditions be brought home to these men, whose business primarily, is to keep the cars moving. The operating department is generally a fertile but little cultivated field by whose exploitation much can be effected along the lines of our present interest.

F—ENGINEERS.

The right side of the cab is no mean factor in this discussion. A careless or ignorant engineer can just about nullify all the efforts of the designer, shop and engine house forces, fuel agent, operating department and fireman. He will work his engine with light throttle and long cut-off when she will do better with the throttle open and the lever back a few notches and vice-versa. He will start with a spasm of slipping which will turn the well prepared fire bottom side up. He will pump his boiler full regardless of steam or anything else, and then shut off the injector and run away two gauges before putting it on again, listening, quite likely with pleasure, to the merry song of the pop. He will never save steam by setting the heater when it can be done to advantage and when he does use it he generally begins by blowing the hose off. He will do many more things which should not be done and will leave undone many which should be done and the net result is wasted steam, which is water, the sum of these being coal which is work and dollars. This man must be educated until he realizes what it is that he is trying to do. Our good engineers, of whom we must thank our stars we have so many, are coal and money savers for the company and work savers for themselves and their mates every time they go out, and must have their just recognition as such.

G—FIREMEN.

The poor abused "tallow-pot" on whose more or less broad shoulders it seems to be the fashion to lay the blame for poor coal record, low steam, washouts, derailments and all manner of war, pestilence and grief generally. There is too much tendency to tell a man going out on some old mill whose boiler "won't hold rocking chairs," and with an engineer who uses only the lowest notch on the quadrant and who believes he should have "the full of the glass" all the time, to "firelight and often" and then proclaim to all and sundry that strenuous efforts are being made along the lines of *Fuel Economy*. I believe that, of the enormous total savings which can be made in the fuel bills of the railroads of this country, the fireman can not effect more than 20 per cent of the aggregate at the outside. If we will educate these men, as we must the engineers and then do our share by paying all possible attention to the points elaborated under headings A, B, C, D, E and F, heading G will take care of itself. No man will shovel a scoop more of coal than he has to and circumstances over which he has no control compel him, assuming that he is properly instructed, to use his 20 per cent, 30 per cent, 40 per cent or whatever it is more that is actually needed to get the train over the road. This is not to be interpreted as meaning that all firemen are doing their best, for such is not the case. It does mean, however, that in the writer's opinion, this part of our problem would be very easy of solution were the others solved satisfactorily and permanently.

Now to what does the foregoing lead us? It is hoped that by its study, we will be able to analyze the individual losses we must combat, indicate the parties responsible for each, and so be more able to make an intelligent attack upon the whole problem.

Considering the losses in detail:

Combustible in Ash.

Loss—Responsible: (a) Design; (b) Maintenance; (c) Engine House; (d) Fuel; (e) Operating Department; (g) Firemen.

Reasons: (a) Because of faulty grate-work design; (b) Improper grate maintenance; (c) Improper fire cleaning; (d) Coal which clinkers instead of burning down to ash; (e) Engines called for service and not used; (g) Fires brought in not burned down sufficiently.

Carbon Monoxide.

Loss—This loss is generally up to the fireman, a fire too heavy increasing the C O percentage. Usually the total loss in this regard is small, many analyses of smokebox gases showing but a trace of this gas. Proper firing will entirely take care of this. Insufficient air admitted under the fire will, however, militate against the best performance.

Sparks and Cinders.

Loss—Responsible: (a) Design; (d) Fuel; (e) Operating Department; (f) Engineers; (g) Firemen.

Reasons: (a) Restricted grate area or anything in the design which will run the fuel rate too high. Brick arch not used. (d) Fuel too friable or too high in slack; (e) Schedules arranged or trains loaded so that engines must be worked unreasonably; (f) Working engine harder than necessary; slipping; (g) Too heavy fire; carelessness in placing coal in fire-box; firing fine soft coal, dry.

Heat Rejected at Stack.

Loss—Responsible: (a) Design; (c) Engine House.

Reason: (a) Boilers so designed that heating surfaces are insufficient or inefficient to absorb all heat possible; insufficient air admitted to fire; (c) Principally through failure to keep heating surface clean, scale and soot being excellent insulators.

Radiation and Unaccounted For.

Loss—Responsible: (a) Design; (b) Maintenance; (g) Firemen.

Reasons: (a) and (b) The radiation losses are probably small and can be reduced to a minimum by proper use and maintenance of covering materials; (g) Probably the greatest loss of those "unaccounted for" is that of unconsumed hydro-carbon gases, such as Methane, or Marsh Gas and Ethylene or Olefiant Gas passing out of the stack. This loss is occasioned by improper firing, generally too heavy, liberating greater volumes of gas than can be properly mixed and burned in the fire-box. A brick arch will help remedy this, acting as a very efficient "mixer." Smoke is an indication of this condition

(although the loss may be present without smoke) as the carbon thus made visible is not the fixed carbon of the fuel but is evolved from the hydro-carbons volatilized in the fire-box, but not properly burned.

The above items take care, in a general way, of boiler losses and from this we come to the engines. As has been said, the greatest loss here is by heat rejected at the exhaust and this, with a simple engine, cannot be much reduced. Compounding will, however, reduce this loss materially and, while compounds seem just now to be anathema in this country, the writer believes that they will ultimately return to favor, as in conjunction with high degree superheat, an over-all power plant ecoficiency can be realized which will exceed that attainable by any other combination.

"Stand-by" and general losses can be reduced by proper loading of coal on cars at the mines and on tenders; by elimination of water and steam leaks; by keeping the pops closed; by getting trains over the road as expeditiously as possible, etc.

Concluding, I want to say that I have tried to treat this subject as largely as it deserves. It is influenced by and influences every phase of railroading. It is larger than any man or group of men. It is not too insignificant to merit careful attention by the august president at his mahogany desk nor too great to be unaffected by the humble fire-knocker in the heat and dust of the engine deck. The labor of every man who, *in any way* has to do with getting trains ready for the road or over the road is reflected in the fuel bill. We must learn to see the dollars in the coal pile, not looking upon fuel as merely so much black, heavy stuff, but as coin of the realm. We must, every one of us, work toward the end that the coal we buy shall all be *used*. Co-operation in and between all departments, in combination with hard, intelligent endeavor must be attained if we are to reach our goal, "Fuel Ecoficiency."

The Mechanical Man

By A. A. Masters, Genl. Fmn., D. & H. Co.

The assertion has been made that the mechanical man on the railroad, does not send no actual cash into the treasury; that he spends the company's money and keeps some money from going out of the treasury; that about 25% of the railroads' operating expenses go to his maintainances, and in fact that he is a pensioner on the company's resources now and forever.

Let us look at this in its broadest sense and see how this works out. It is true that each month a certain amount is set aside out of the earnings to maintain the mechanical department, and that he alone does not actually send any money into the treasury.

Now, who does actually send this money into the treasury? Usually some clerk in the treasurer's department, but the act alone of placing the money in the treasury does not make the clerk the producer. The producers are those that are actually engaged in production or that makes this possible.

Considering the strained conditons of the railroads at the present time, due to all manners of adverse legislation, compulsory inspection, safety equipment, new equipment, compensation due to injury, increased wages in every department, decreased revenue, full crew, arbitrary restriction that increases operating expenses, but do not increase net earnings, it goes without saying that no railroad will long maintain a non-producing department that absorbes 20% of its operating expenses.

Let us imagine a first class railroad with a crew called (not forgetting the third man to make a full crew), to transport 500 tons of coal, 300 tons of iron ore and 100 tons of wheat, 100 miles in, say, 10 hours. Everything is in order when at one mighty stroke the mechanical man and all his contrivances for transportation are swept away. The result would be that every department on the railroad would be automatically forced into the non-productive class without a ghost of a chance to place one dollar in the treasury and they would all be pensioners on the company, while they were retained under pay.

To get a good impression of what transportation and travel was before the mechanical man, let us study that picture of the man who a few thousand years ago availed himself of the first known methods of transportation. We see a primitive man, seated on a log, that had fallen into the river, floating with the current; on the log he has a few clams tied up in a skin; such was transportation before the arrival of the machine. The thought that appeals to us, as railroad men, is that this method is not a high dividend producer.

In looking at a train of gears, our first impression is that the gear on the end of the train, and that is turning the screw in performing all the work and carrying all the load. If we remove one gear from the train all production ceases; even a few teeth out of an intermediate gear cripples the entire train, just as poor and inefficient power, cars out of repair and poor terminal facilities cripple and reduce the earning capacity of the railroad. There is a vast difference between the fifth wheel on a wagon or the fourth wheel on a wagon, due to the fact that one constitutes 25% of productive ability and the other is distinctly in the non-productive class.

In other lines of business the mechanical man's productive ability is still more clearly marked. The automobile industries (another form of transportation) often pride themselves on their efficient sales agencies and service stations. But the productive side of the business is largely up to the mechanical man, who is entitled to the largest amount of the credit, in his organization for placing money in the treasury. The financial manager and head of one of the largest manufactures of the kind, has recognized this and has rewarded his mechanical man accordingly. On the western prairies, it is no uncommon sight to see a giant tractor at work 10 to 12 furrows at one time. The Syrians still plow with a stick, but tens of thousands of bushels of wheat are shipped from the West yearly, and we do not hear of Syria being a wheat producing country. Evidently the Syrians do not know about the possibilities of the mechanical man.

Let us suppose that a miracle should happen to-morrow and that all the war equipment, produced by mechanical men in the last 50 years, that belong to one side of the contending armies in the present old world war should be destroyed. It would not be even necessary to declare peace, as sticks and stones do not constitute modern implements of warfare.

Under the present high pressure railroad methods, production devolves equally on all departments, and the weakest and most inefficient department gets the most harrowing in an effort to bring the productive ability of this particular department up to the remainder of the organization.

It is therefore up to every department to obtain the highest efficiency and to deliver the best of service possible in order that all other departments may be able to carry out their destiny, that of bringing in the shares, bearing in mind that the hole that is now in the bottom of the treasury where the money runs out is nearly as large as the hole where the money goes in at the top. If you do not believe this, buy some railroad stock and watch it go up and unless Billy Sunday soon gets at the public for countenancing this condition it will require the united effects of all to keep even.

Forged and Rolled Steel Pistons*

The Necessity for Reducing the Weight of Reciprocating Parts and a Description of a New Method of Manufacture

By W. W. Scott, Jr.

It is not the intention nor is it necessary to present in this paper any new data as to the effect of the inertia of reciprocating parts of a locomotive upon the rails or upon the operation of the locomotive itself, but in order to freshen our memories as to investigations already made on this important subject and to prove the positive necessity for reducing the weight of reciprocating parts, it is proper at this time to review briefly the various facts brought out in the past.

In 1896 a committee of the Master Mechanics' Association filed a report on "Reduction of Weight of Reciprocating Parts in Locomotives," which ended as follows: "It must be borne in mind that these designs (referring to built up pistons, wrought iron cross heads, etc.) were adopted because of their low first cost and cheapness of maintenance and the question of weight was considered of secondary importance, and your committee has not been able to learn of any method of design or construction, that has yet been brought out by means of which the weight of reciprocating parts can be materially reduced without entailing considerable increased costs over former methods of construction." In 1896 then, cost came first and weight second, but in 1914, with the tremendous increase in tonnage, weight of locomotives, wheel loads, etc., the question of weight has become as important if not more important, than first cost, and it is the intention to explain later, the methods by which the views of this committee can be met.

It is a simple problem to counterbalance the revolving parts of a locomotive to obtain a good vertical balance, and it would be an easy matter to counterbalance the entire weight of the reciprocating parts of a steam locomotive to obtain a perfect theoretical horizontal balance, but unfortunately, the vertical disturbance on the rails, always dangerous, is increased in proportion to the amount added to the counterbalance, necessary for the revolving parts. This condition has led to the practice of adding an "overbalance" varying from 30% to 75% of the total weight of the reciprocating parts, or more, to the counterbalance necessary for revolving parts alone.

The Influence of Heavy Reciprocating Parts.

So far as balance is concerned, the modern electric locomotive is almost perfect, for there are no reciprocating parts to be partly or fully balanced. The connection rods, where used, are "rotating links between rotating elements," and as all weights are revolving the locomotive can be counterbalanced perfectly for all speeds. Hence the draw bar pull is practically constant, the weight on drivers is constant, there is no hammer blow on the rail and the locomotive is capable of much greater speed with safety than the most perfect reciprocating steam locomotive.

As evidence of this the record of over 130 miles per hour made by electric locomotive on Berlin-Zossen Lines in Germany in 1903 has not been equalled by any reciprocating steam engine in this country or abroad; the fastest time for a steam locomotive of which there is authentic evidence being that made on the S. F. & W., March 1st, 1901, of 107.9 M. P. H., and that for a very short run.

It is said that the speed of a steam locomotive is limited to the steam capacity of its boiler, and to a certain extent it is true, but it is evident that any locomotive operated by steam would be liable to "jump the track" at a speed of 130 miles per hour for the reason that the vertical pressure on the rail, due to the centrifugal force of the overbalance in driver, increases as the square of the velocity regardless of what proportion of reciprocating parts weight is counterbalanced, and in every case there is a natural effort on the part of the wheels carrying the overbalance to rise from the rails at high speed. Professor W. F. M. Goss proved this to be an absolute fact through experiments in locomotive testing laboratory at Purdue University. It was also proven in the locomotive testing plant at St. Louis Worlds Fair in 1904. In the latter case the drivers of one engine actually left the rails at every revolution at ordinary high speed, while every engine tested showed great variations in weight on the drivers.

In Vol. XII, Part 3, page 65, proceedings American Railway Engineering and Maintenance of Way Association, 1911, are given the necessary data to figure the counterbalance disturbance of a number of locomotives typical of those in use in the United States, and it has been shown that at 80 miles per hour, a speed which is by no means infrequent for many passenger locomotives, the impact due to overbalance alone in the case of many engines, is nearly 100%; in case of quite a number over 135%, one engine being over 152%. When the counterbalance disturbance is over 100% the drivers actually lift from the rail when the counterweight is up, and when down, produce a true hammer blow, the force of which is actually dangerous.

F. J. Cole while mechanical engineer of the Baltimore & Ohio made some interesting tests which also showed, to summarize briefly, that counterbalancing necessary to offset the weights of revolving parts and proper proportion of reciprocating parts lifts the main drivers off the rails at ordinary high speeds (50 miles per hour for freight locomotives). In making a comparison in effect between "light" and "heavy" reciprocating parts, he uses the following:

Eight-wheeled engines having four coupled drivers and four-wheeled trucks.

	Diameter drivers	—60"
	Size cylinders	—18" x 24"
	Weight on drivers	—72,300 pounds
	Steam pressure	—160 pounds
Weights of reciprocating parts:		
	Piston and rod	—285 pounds
Heavy 634 pounds	Cross head	—138 pounds
	One-half main rod	—211 pounds
		634 pounds
	Piston and rod	—219.56 pounds
		(using solid plate piston)
Light 420 pounds	Cross head	— 92.73 pounds
	One-half main rod	—107.50 pounds
		419.79 pounds

and shows that at 60 miles per hour the alternations of weight during one-half revolution for heavy parts is

* A paper read before the Railway Club of Pittsburgh, November 27, 1914.

63,920 pounds, the actual weight on the drivers being 40,340 pounds minimum and 104,260 pounds maximum, as compared to alternations of weight during one-half a revolution for the lighter parts 45,592 pounds, the actual weight on drivers being 49,504 pounds minimum and 95,096 pounds maximum. These determinations were made before forged and rolled pistons, and hollow piston rods were in vogue. Doubtless the reciprocating parts could now be designed to be much lighter than 419.79 pounds.

It is necessary, of course, to balance the reciprocating parts so that the engine will not buck or plunge and will have a fairly constant draw bar pull, but in the light of present-day knowledge the old idea of using heavy reciprocating parts simply because they are strong and cheap, seems like putting the cart before the horse. It is evident without argument that the maximum weight on drivers should be figured for a higher speed than the locomotive makes on ordinary runs, because the static driver load in steam locomotives, unlike that in electric locomotives, is no indication whatever of the blow transmitted to the rail at speed, and has little to do with the effect on track, unless the static load is excessively high and causes a crushing of the rails due to rotating effect. The important fact is that the overbalance in the driver hammers the rail when the locomotive is in motion. The greater proportion of broken rails occur during freezing temperatures. Many of them are diagnosed as "crystallized." Let it be here stated that rails do not crystallize; such rails are broken by the centrifugal force of the overbalance coming at a time when the track is frozen rigid and cannot cushion the shock. To reduce the overbalance blow is to reduce the number of broken rails.

The Advantages of the Rolled Steel Piston.

(a) In reducing weight of reciprocating parts.
(b) In reducing cylinder wear.

Would it not be wise to rule that no locomotive (let us say passenger at 70 M. P. H., freight at 45 M. P. H.) shall have an impact on rail due to overbalance of more than 30% of the static weight on the drivers? This is much better than the ordinary American practice, although it is strictly followed by the Pennsylvania Lines East of Pittsburgh, whose maximum weight on one driving wheel is 32,500 pounds. No engine is allowed to show more than 30% dynamic augment (at the speed mentioned) or 9,750 pounds per wheel. That such a rule is not a hardship is proven by the fact that some of the German railways allow only 15% dynamic augment at high speeds. When one considers the fact that in this country the average is about 62½% it is high time that it be reduced.

Having made the rule referred to, it will be an easy task to work back to the allowable weights for reciprocating parts: it will at once be seen that the ordinary piston rod, piston, crosshead, and main rod will not do; that it will be necessary to go deeper into designs and stresses than was the custom when lighter locomotives were in common use; it will be found that a forged and rolled piston will be from 10% to 60% lighter than the old types; that boring the piston rod will reduce its weight about 25%; that the substitution of a good alloy steel for ordinary steel will reduce the weight of cross head from 10% to 30%; that I shaped main rods are not only lighter but stronger than those of rectangular cross section.

Through the courtesy of J. T. Wallis of the Pennsylvania the formula for calculating counterbalances required at tread of driving wheel for Pennsylvania Railroad locomotives is here given:

The maintenance of way department has limited the maximum dynamic augment at 70 M. P. H. to 9,750 pounds per wheel, which is 30% of the maximum weight of driver on rail.

Wr = Total weight in counterbalance at radius (r).
W_R = Total weight in counterbalance at radius (R).
W_1 = Weight revolving parts in pounds, per wheel.
W_2 = Weight reciprocating parts in pounds, per wheel.
R = Radius driving wheel in inches.
r = Radius crank pin circle in inches.
g = Acceleration of gravity in feet *per sec. per sec.* = 32.2.
$100x$ = % reciprocating parts balanced.
xW_2 = Weight in counterbalance (Wr) above that for revolving parts.

$$Wr = W_1 + xW_2 \quad \text{and} \quad W_R = \frac{r}{R}(Wr).$$

$$n = \text{Number revolutions per second} = \frac{\text{R. P. M.}}{60}$$

$$\text{Dynamic augment} = \frac{4\pi^2 r n^2 x W_2}{12 g} = 9{,}750.$$

$$\text{Whence } xW_2 = \frac{9{,}544}{r n^2}.$$

$$\therefore Wr = W_1 + \frac{9{,}544}{r n^2}$$

$$\text{and } W_R = \left\{ W_1 + \frac{9{,}544}{r n^2} \right\} \frac{r}{R} \text{ Desired at tread of wheel.}$$

This formula is based on dynamic augment of 30%. If it is desired to work lower than 30% the figure 9,750 pounds shown above can be changed to agree with percentage of driver load agreed upon.

For the benefit of those who may desire to calculate the dynamic augment of locomotives already in service, constants worked out by Baldwin Locomotive Works will be useful and are here given. (It must be borne in mind that these figures have been worked out on the basis that speed in miles per hour equals diameter of driver in inches.)

Illustration	
	26″ Stroke
	60 M. P. H.
	70″ Diameter driver

$$\text{Dynamic augment} = 41.7\ W \frac{60^2}{70^2}.$$

Stroke	Dynamic Augment	
18″	29.1 x W	At diameter speed.
20″	32.3 W	
22″	35.5 W	
24″	38.5 W	
26″	41.7 W	
28″	44.9 W	
30″	48.4 W	
32″	51.7 W	
34″	54.9 W	

W = Excess weight at stroke distance.

A rule making necessary the reduction of reciprocating weights may, at first thought, seem to be a hardship but a little reflection will show that to do otherwise, even though it adds a trifle to the first cost of the locomotive, is to be "penny wise and pound foolish." (Let it be stated here that a forged and rolled steel piston will not increase the cost of a locomotive.) The value of all the reciprocating parts in all locomotives in this country probably does not exceed 1% of the value of the rails in track, and it is positive economy to save the greater investment

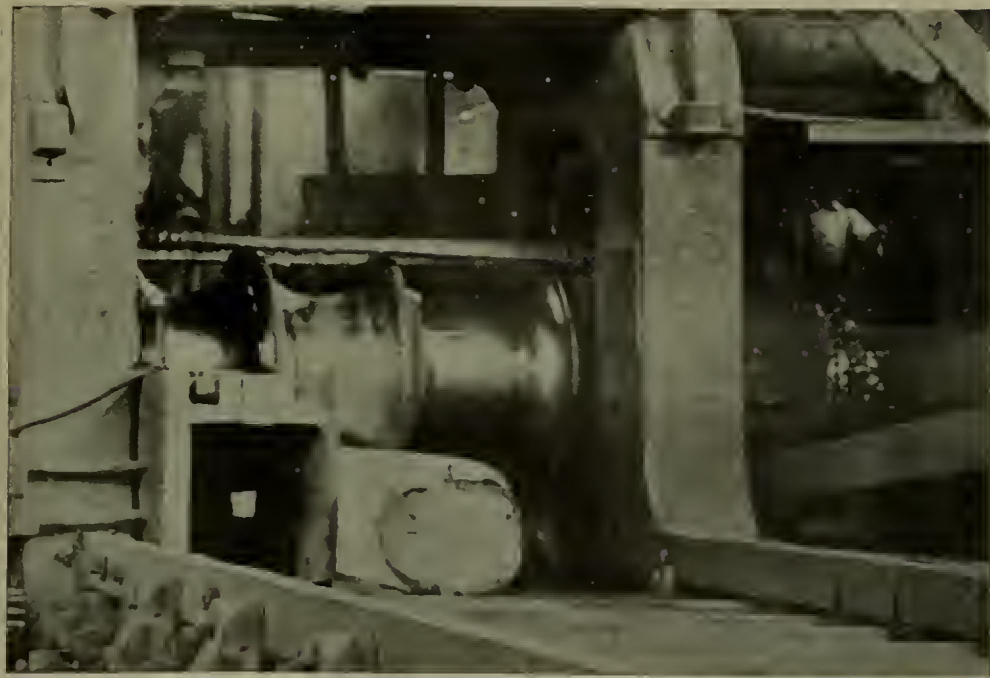


Fig. 1—Ingots Being Rolled Into Round Bloom.

in rails by lightening the weights of reciprocating parts which represent the smaller investment.

In this progressive age it behooves every man to ascertain how his decisions affect his entire business and not one particular department. It develops then into the question whether it is cheaper to lessen the dangerous blow on the rails by lightening reciprocating parts, or increase the weight of rail. One thing or the other must be done in the near future.

As evidence that the question of lightening reciprocating parts is beginning to receive the attention it deserves, it is only necessary to mention two specific cases recently described in the technical papers. The first is that of the Pennsylvania which, at its Altoona shops, has recently developed the efficient types E6s—K-4 and Lls locomotives. They are worthy of most careful study by engineers and laymen interested in steam engines; their reciprocating parts are said to be the lightest ever used in an American locomotive having the same size cylinders. The pistons are of one piece solid, forged and rolled from 35% to 50% O. H. steel untreated, made by the process about to be described, and are almost 50% lighter than the type which they superseded, the piston for E6s (4-4-2 Type) 23½" cylinders weighing 144 pounds finished. Each piston carries two packing rings of cast iron sprung into their grooves in the usual manner. Although very light, they have proven their ability to resist extraordinary shocks, because, while the type of piston having a cast iron bull ring bolted to a cast steel center sometimes fractures during very low temperatures on account of steam condensing in the cylinders, the solid rolled steel piston has given no trouble under exactly the same conditions; in fact, one case was reported where the shock, instead of bending or breaking the piston, was transmitted to the main rod, which bent three inches out of line and worked in that condition to the end of the division, where the deflection was detected.

The other case is that of 2-10-2 freight locomotives built by Baldwin Locomotive Works for Chicago, Burlington & Quincy, cylinders 30" diameter, 32" stroke. In 1912 several of these locomotives were built which proved their efficiency, but the revolving and reciprocating parts were so massive that the drivers (60" in diameter) could not accommodate the proper counterbalance and it was found necessary to key a counter weight or "bob" weighing about 3,000 pounds to the main axles, the main wheel being heavy on pin side 590 pounds even with the "bob." These locomotives were duplicated in 1914 in all respects except that the weights of reciprocating and revolving parts in two of them were reduced so that not only was the counter weight on main axle unnecessary, but the counterbalances in the drivers were reduced about 4,000 pounds, making a saving in dead weight of about 7,000 pounds each, the rated tractive effort (71,500 pounds) remaining the same, and although the main driver is still heavy on the pin side, the weight has been reduced 35 pounds, making it 555 pounds instead of 590 pounds. The total weight of reciprocating parts in the locomotives having "bobs" on the axles, is 2,315 pounds; in the locomotives without "bobs," 1,936 pounds. The reciprocating parts are about 16% lighter in the latter.

The pistons of the lighter locomotives are Z type, the steel center being riveted to a cast iron bull ring carrying two packing rings. It is probable that the weight of reciprocating parts might have been still further reduced had a solid piston been used.

It is interesting to note in passing, that the Pennsylvania locomotives mentioned, as well as the lighter C. B. & Q. locomotives, are fitted with bored piston rods, and that the main and side rods are I-beam section, while the driving and trailing axles on the P. R. R. locomotives are bored from one end to the other to facilitate quenching and tempering.

METHOD OF MANUFACTURE.

If, then, the decided advantage of lightening reciprocating parts has been proven it is interesting to note that a new method of manufacturing pistons has been developed by means of which a saving in weight of 10% to 50% or possibly more for certain types can be accomplished. The process has been worked out by the Carnegie Steel Company at its Homestead car wheel plant where, among other circular sections, pistons are made practically from "ore to finished product."

The ingots are cast according to usual open hearth furnace practice in moulds 22" x 22" and about 6 to 7 feet long. After stripping, and soaking in the furnaces at the blooming mills in customary way the ingots are rolled into round blooms 15" in diameter (See Fig. No. 1) and, while hot (See Fig. No. 2) sheared into discs or "cheeses" of the proper weight to produce the required section by

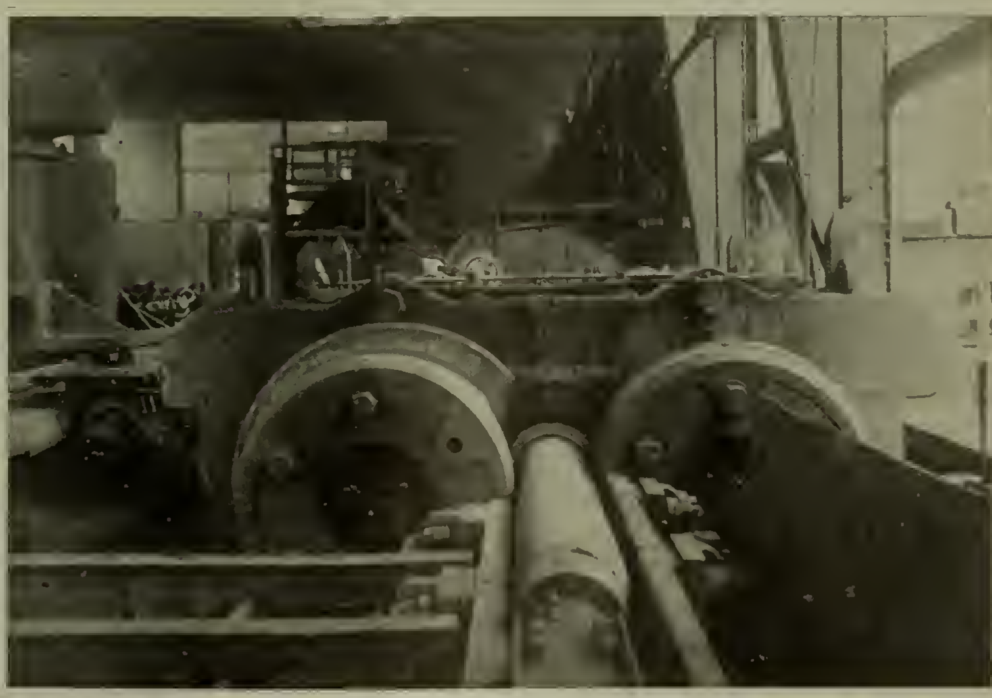


Fig. 2—Blooms Being Sheared Into Discs While Hot.

further forging and rolling to be described later.

At this point your attention is called to the forging and rolling work done on the steel used, through the reduction of a 22"x 22" ingot into a 15" round in the blooming mill (Fig. 1). This reduction represents a very important refinement of the rough cast ingot into a forged product of uniform and sound structure, which is far superior in its adaptability for the final forging operations than a raw casting of steel.

There may arise in your mind the question why these blocks are sheared from rolled rounds into the form of discs (Fig. 2) rather than from flat slabs into the form of squares, as made for annular sections at Homestead and other plants some years ago. The answer is the keynote of the present day success of rolled steel sections, such as passenger, tender and freight wheels, gears for electric railways, heavy duty double flange crane track wheels, etc., and lies in the fact that the outside of the ingot which, according to the nature of the elements composing it is its best part, finally becomes by this process the outside or periphery of the section, while the center, naturally the weakest part, eventually becomes the core and goes back into scrap. It is, of course, understood that sufficient discard has been made from the rolled round bloom to insure freedom from piping.

Fig. 3—Inspection of Discs for Surface or Rolling Defects.

Fig. 4—Heating Discs in a Continuous Gravity Furnace.

The discs when cold are carefully inspected (See Fig. No. 3) for surface or rolling defects, and any present are either chipped out cleanly by means of pneumatic chippers or the disc is scrapped. From the inspection yards the discs are taken to the wheel plants, and in the cases of pistons, gear blanks and other sections lighter than freight, tender and passenger wheels are heated in a continuous gravity furnace, insuring the rolling of each disc in its proper order at a uniform heat (See Fig. No. 4").

By means of a steel dog running between two rails the disc is transferred to a hydraulic press, whose function is to pierce a hole considerably smaller than the rough bore desired about half way through the center on the axis of the disc in order that the disc can be held between the rolls, on a pin, until the hydraulic pressure applied grips the piece and forging commences (See Fig. 5). The mills were designed and patented by E. E. Slick and are unique in that they are the first of their kind ever built and are original in every respect.

Each mill, of which there are two, is composed of two rolls or dies facing each other, set on the ends of two shafts which are out of line; one mill having the shafts approximately 14° and the other approximately 7° out of parallel. It is evident therefore that when the dies are brought together before the shafts turn, the disc is subject to a forging action. When sufficient forging has taken place under a hydraulic pressure starting at about 700,000 pounds and intensified to 3,000,000 pounds maximum at the finish in the larger mill, to start the piece into the contour of the die, steam power furnished by a 2,500 H. P. engine is applied to revolve the roll shaft and from this point until the piece is taken from the rolls it is subject to both rolling and forging action, which insures close grained, well worked metal.

In passing, it is interesting to note the extra heavy equipment necessary to work steels as high as, in some cases, 95 carbon, into annular sections.

Bed plates weigh	—164,000 pounds
Entire weight, including engines	—1,200,000 pounds
Size of die shafts	—31"
Size hydraulic cylinders	—40" dia. x 24 stroke

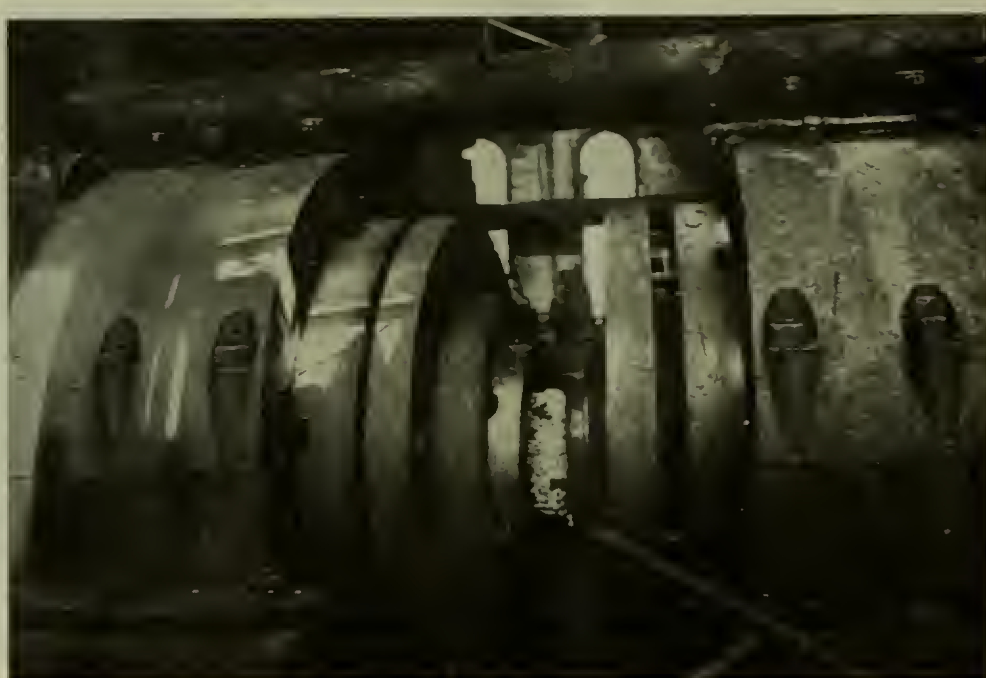


Fig. 5—Mill for Forging and Rolling the Discs.

Outside diameter rolling
bearing —6′ 0″
Diameter of die —5′ 10″
Size of rollers —5″ dia.

After rolling the piece is put through a shear, which automatically frees it of the "flash" which is usually present in a flat forging. In the same machine the core previously mentioned as having been in all cases the center of the ingot is punched out (See Fig. No. 6) to make the rough bore, thus freeing the steel of any undesirable segregation that may be present after the discard from the round bloom has been made at the blooming mill shears. (Fig. 2.)

Fig. 6—Removing the "Flash" and Punching Out the Core.

An experiment was made to trace the movements of the center of the ingot during the process of manufacturing an annular section. A bar of copper 1″ in diameter was inserted in a hole drilled through the axis of the disc while cold. The disc was heated and worked in the usual manner. After the core had been punched out it was split longitudinally with the copper

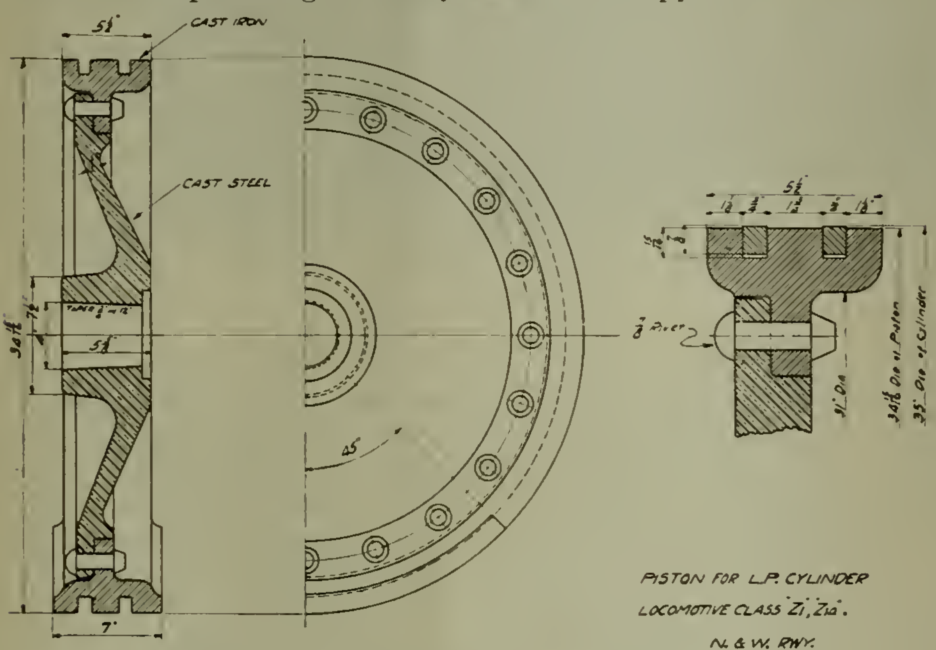


Fig. 7—Customary Practice of Riveting Cast Iron Bull Ring to a Steel Center.

bar. The latter was found to have varied from its original position slightly less than an inch, the maximum variation from the center line occurring about half way through the section, indicating that the steel had been thoroughly worked all the way through.

After punching the bore, the piece is rough turned on the periphery, on the edges of the rim and on both faces of hub in order that any scale or surface defects may be eliminated and clean sound metal assured.

After passing final inspection the product is ready for shipment. The method just described refers only to plate pistons.

Solid plate pistons are not new, steel castings in this form having been used as long ago as 1900, in Europe, and are now used more or less extensively in this country in low pressure cylinders of compound engines where the diameters are such that the weight of a box or double wall piston would be prohibitive. This brings to mind the interesting question of the wear of the piston against the cylinder. It is commonly believed that pistons wear the bottom of the cylinders, but a close investigation will show that a fair percentage of cylinders wear on the top, due in part to improperly lined guides, loose cross heads and to the fact that when the locomotive is working under steam the pressure works first under the piston rings, and tends to throw the piston upward against the top of the cylinder. It is no doubt true that a steel piston working in a cast iron cylinder will score or cut the latter *if they come in contact,* and with this contingency in mind almost all American designing engineers bolt or rivet a cast iron bull ring to a steel center (See Fig. No. 7), the former being provided with grooves for cast iron piston rings.

CONSTRUCTION RECOMMENDED.

There have been some noteworthy diversions from this practice, however, particularly on locomotives operated by the Norfolk & Western. One method is to pour molten iron (See Fig. No. 8) into a groove machined in the face of the piston. Another is to pour molten bronze in the same manner (See Fig. No. 9), afterwards turning in a lathe to the proper diameter. Both of these types are said to operate efficiently, but it is not the easiest task in the shop to replace the worn down bearing surface, as the shrinkage of metals must be well understood by the workmen in order to get a tight fit. It is suggested here,

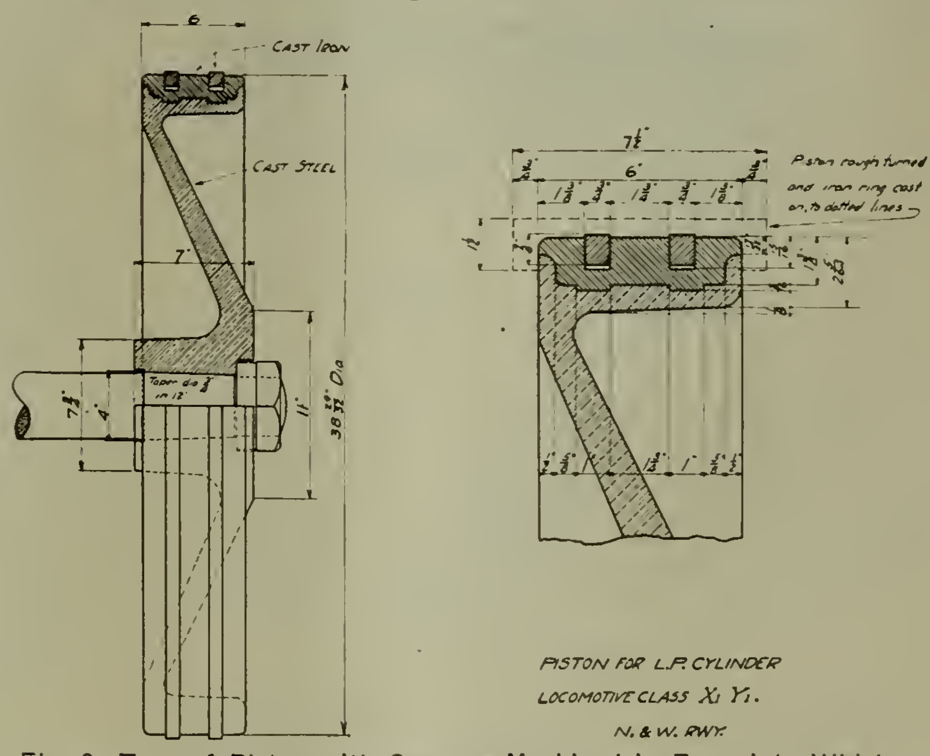


Fig. 8—Type of Piston with Groove Machined in Face, into Which Molten Iron Is Poured.

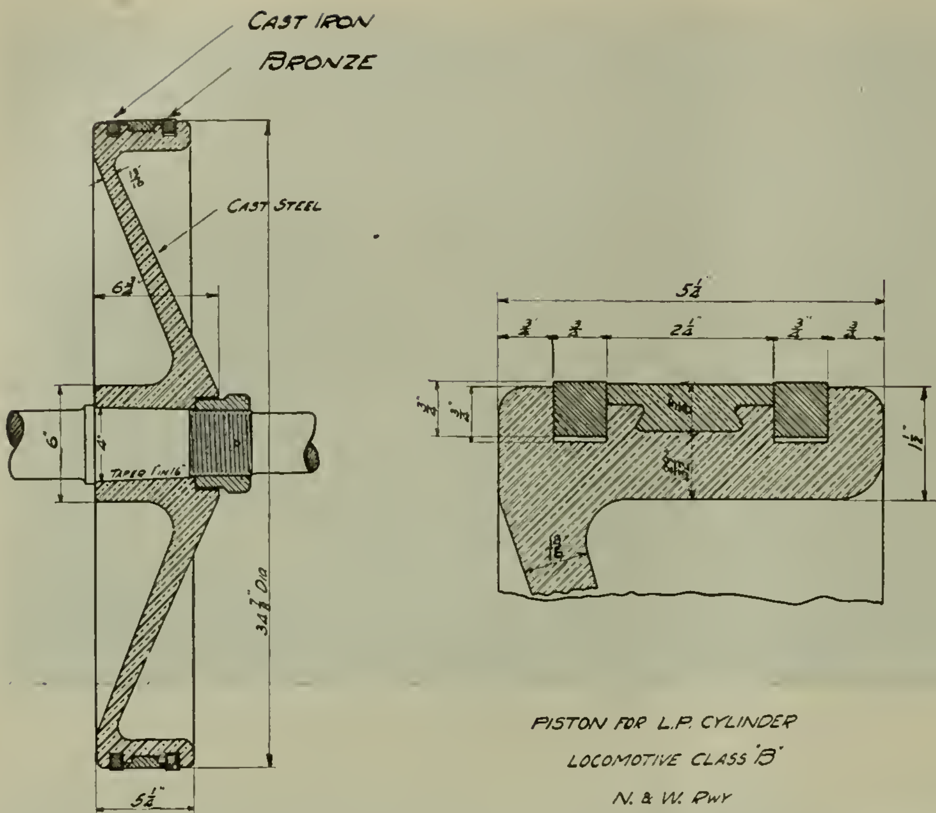


Fig. 9—Type of Piston with Groove into Which Molten Bronze Is Poured.

therefore, that the practice followed by designers of heavy stationary engines be followed in using solid rolled steel pistons in locomotives. That is, to cut one or more dove-tailed grooves in the face of the piston, insert segments of good malleable bearing metal and hammer it solidly into the dove-tailed grooves (See Fig. No. 10). This has the added advantage of forming an oil groove or pocket between piston rings and bearing metal face. It has also been found that bearing metal in face of piston, polishes the cylinder walls, thus facilitating lubrication. Another suggestion is two rings of bearing metal. (See Fig. No. 11.)

The solid rolled steel pistons for the Pennsylvania just described (See Fig. No. 12) are used with extended rods which have the advantage of reducing cylinder wear and simplifying lubrication. The extended rods in use some years ago, which were discarded, are not to be compared

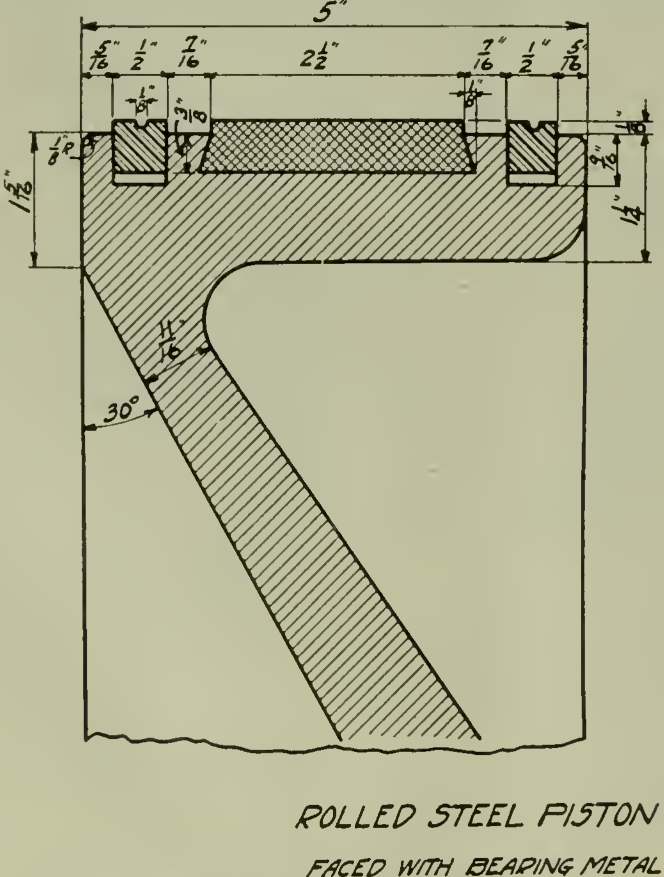


Fig. 10—Suggested Bearing Surface for Pistons.

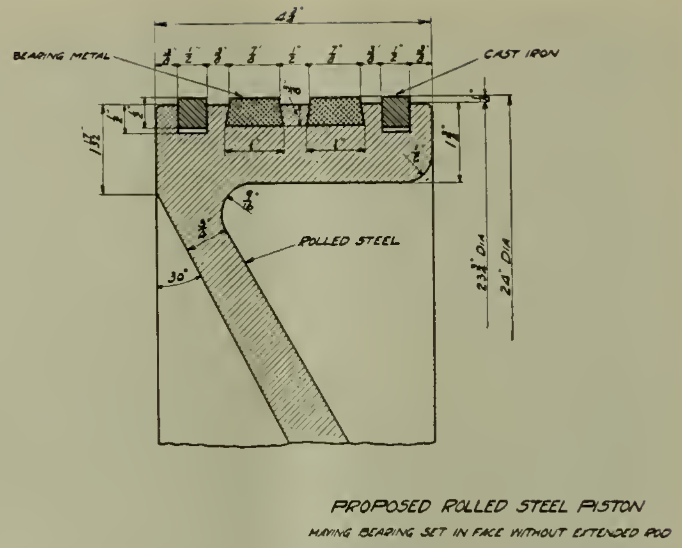


Fig. 11—Suggested Bearing Surface for Pistons.

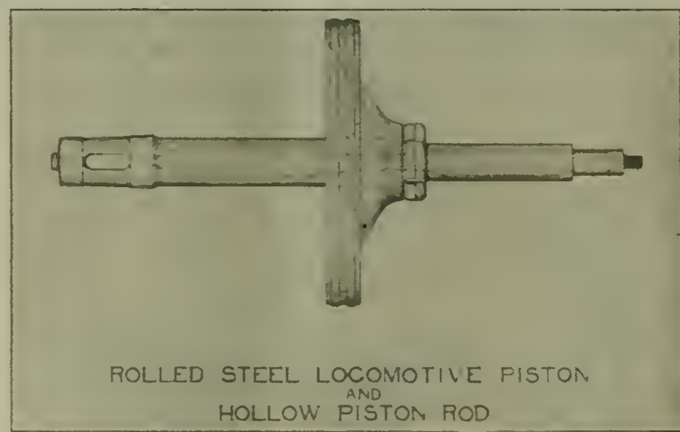


Fig. 12—Solid Rolled Steel Pistons Used on the Pennsylvania.

with those in use on the latest types of engines, for the old rods and pistons were much too heavy, the pressure on front bearing being as high as 50 pounds per square inch, while the new type of extended rod has a pressure on the front bearing of only 10 pounds per square inch.

The old types of extended rods were of no particular value in saturated steam locomotives where good cylinder lubrication was comparatively easy to obtain. With superheated steam, however, a very different condition prevails as to cylinder lubrication, and it is the part of discretion to prepare for the contingency that when the engine is drifting long distances the cylinders may not be properly lubricated.

If then there may be times under certain conditions when the cylinder is comparatively dry with the piston riding on the cylinder, it is certainly better practice to have an anti-friction metal in contact with the cylinder rather than even the best of cast iron, so that wear will be reduced to a minimum and scoring eliminated.

For this reason it is recommended that solid steel pistons (unless supported by an extended rod) be faced as before mentioned with a bearing metal that will not only stand a temperature of 640° F., but will also be malleable enough to permit of hammering in segments into dovetail grooves. We have made laboratory tests of a new bull ring metal, which showed an "exuding" point of 1,150° F., an average scleroscope hardness of 8, and which can be easily peened into a dove-tailed groove ¼″ to ⅜″ deep.

This is not an experiment, for pistons as large as 50″ in diameter, faced with bearing metal, are in use in many of the heavy duty rolling mill engines in the vicinity. Such a piston weighing 3,400 pounds may be found in operation at the Homestead Steel Works.

Time and test will prove whether the bearing metal mentioned will stand the ravages of superheated steam, but it is safe to assume that if it will not do, another bear-

The Effect of a Test Run at High Speed on 80-pound Rail. The Counterbalance Produced a Blow Heavy Enough to Bend the Rail.

ing metal can be developed which will be satisfactory. We have known for many years that the proper kind of bearing metal will reduce friction, and losses by friction in locomotive cylinders are more than a mere trifle.

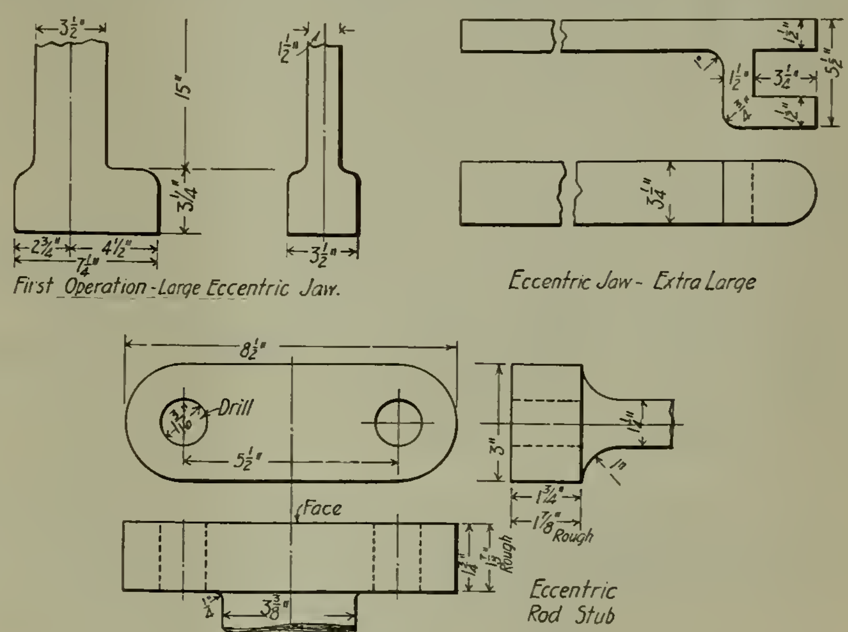
It has been suggested that rolled and forged pistons be faced with a cast iron ring like piston rings, except wider, set in a groove ⅛″ less in depth than the thickness of the ring, the ring to be halved, or in three segments, and when assembled in piston to be slightly less in diameter than the cylinder. This scheme should work whether the bearing rings are fastened to the piston or simply held in place by the cylinder walls. It has a distinct advantage in ease of replacement of bearing face as well as being economical.

Many ways can be worked out by which a forged and rolled steel center can be attached to cast iron bull rings, such as the use of retaining rings or spring keepers, but if cylinder bushings or cylinders are to be protected against excessive wear an anti-friction face is the logical progression. It is, of course, impossible to roll a box piston of any other kind than one having a single plate. It is possible to roll centers that are intended to carry a cast iron bull ring, but the tendency of the times is to reduce the number of parts as well as the weight, and therefore the solid forged and rolled steel piston takes its place as the latest development in this line.

MAKING ECCENTRIC RODS.

By A. Bennett, Genl. Fmn., C., M. & St. P. Ry., Milwaukee.

Our method for making eccentric rods complete is given herewith, together with illustrations showing the two operations for the jaw and one for the stub. Eccentric rods are made complete in three blows of the four inch Ajax forging machine at the locomotive blacksmith shop of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis. The jaw of this rod is made from 3½ in. x 1½ in. bar iron in two operations. From one set of dies with two headers the first blow of the machine is made in the upper part of the die, and thus forms the iron into the shape of a foot. The second blow is made in the lower part of the die and completes the jaw. To make this jaw, which requires seventeen inches of stock, we have to use a back stop and one heat for each operation. We can turn out about three per hour.



Making Eccentric Rods.

The stub end, which requires 10½ in. of stock, is made complete from 3¼ in. x 1¼ in. bar iron in one blow. This end is shaped in the die, with the header made oblong, 8½ in. x 3 in., the size of the foot, which pushes the iron into the proper shape. We also have to use the back stop in making the stub end and can turn out about five per hour with one operator and helper.

A Correction

The statement relative to personal injury records on page 119 of the April issue should have referred to the Grand Trunk Pacific Ry. alone. However, the record on the Grand Trunk has also been very gratifying.

Handling Supplies at Engine Houses

An Outline of the Methods of an Eastern Road Showing Record Forms and Methods of Reclaiming Materials

By Jesse E. Tefft, N. Y. C. R. R., Peekskill, N. Y.

At the main terminal of the division, the handling of supplies for locomotive use should be given careful consideration, as it is this point that the smaller outside engine houses look to for material which cannot be quickly obtained from the general storehouse, and while as a matter of economy it will not do to carry an excessive stock at any point, the division terminal should have sufficient material to meet all damands, and avoid the holding of power out of service for repairs an unwarranted length of time. The principles outlined in the following have been in practice on a large Eastern railroad for the past several years under the personal observation of the writer, and excellent results have been obtained.

All material required is ordered on requisition blank, as shown in Fig. 1, whether it is to be obtained from the general storeroom or another engine house or department. A general requisition covering requirements for 30 days is made in the early part of each month, and special requisitions from time to time as occasion requires. Copies of these requisition forms are kept in the storekeeper's file, arranged in numerical order, and this, of course, brings them in date order for ready reference.

When the supplies are forwarded, a shipping invoice (Fig. 2) accompanies them by mail, the consignor sending the duplicate to the consignee and the original to the accounting department for pricing, after which it is also forwarded to the consignee for his record. On receipt of the original invoice, the prices, weights, etc., shown thereon are carefully scrutinized to detect any errors, and forms are then matched up with duplicates to make sure that an original is received for every duplicate on file, after which the duplicate is signed and returned to the consignor as his receipt, the originals being filed in numerical order according to shipping department number.

On receipt of the material ordered, it is first entered in receiving book (Fig. 3), and this book is then checked against shipping invoice to further guard against error in amounts received. If found correct, each item received is checked off on copy of requisition on file, and shipping number of invoice marked thereon, until all items ordered have been either received or cancelled. As fast as each requisition is filled or cancelled, it is removed from the open file and placed in the closed file in numerical order for future reference.

All material received, except new material, is immediately marked with a tag showing that it is repaired or second hand. This to insure the proper charge being made when disbursed.

The storekeeper also maintains a stock book or record of material (Fig. 4), and at the time requisition is made up, he enters the number of same and the amounts of material it covers in this book in the column "Ordered" under the proper month. An inventory of stock is taken at the close of each month, and recorded in stock book under heading "On Hand." By going through copies of open requisitions on file, the items ordered and not yet received can be determined and entered in stock book under column "Due." With this method a close check is kept on all supplies, and anything not received within a reasonable length of time is either "punched" for shipment or cancelled, thereby keeping the records straight and the stock up to the standard at all times. It is also possible to quickly determine the price of any given article by first referring to stock book for requisition number ordered on, then to requisition file from which the

No. 1

motive power Department april 15 1915

Mr. John Smith

Please furnish the following articles and ship to Mr. John Jones

at Buffalo *and charge the value thereof to the accounts indicated in "Charge To" column. Ship by* Pass. *Send Invoice to* John Jones

INSTRUCTIONS.

1. This form to be used by departments when making requisitions on each other for materials (except on Purchasing Department).
2. The department making requisitions will place its number in the upper right hand corner.
3. Always give full and complete shipping instructions.
4. Always state to whom and where shipper's invoice should be sent.
5. Where sizes are required, be sure and give them. Always give complete description as to class and kind of material wanted.
6. In "Required for" column indicate for what purpose material is required. In "Account Chargeable" column show the account or accounts to which the value of the material should be charged.

(RECORD OF SHIPMENT)

QUANT.	UNIT	ARTICLES AND SIZE	REQUIRED FOR	CHARGE TO	S. O. NO.	DATE	CAR NO. AND INITIALS	WEIGHT
4	no.	5 1/2 x 10" Journal Bearings	Engine 3800					
		"when received mark number of shipping invoice hereon"						

Fig. 1.

1-15. 100m. (WSG 114023)
FORM A. D. 523.
SIZE 8x10½

SHIPPING INVOICE.

From Albany *Shop or ~~Division~~ Dept. Date 19 Shipping Dept. No. 1 Month's Acct.
Mr. John Jones Receiving Dept. No. Month's Acct.
The following articles have been shipped to Buffalo Acc'ting Dept. No. Month's Acct.
For
*Cross out "Shop" or "Division" as the circumstances require.
John Smith

Car Number and Initial	Reqn. No.	QUANTITY	UNIT	SIZES	ARTICLES	PRICE	AMOUNT	ACCOUNT CHARGEABLE
Pass. trn	1	4	no.	5½ x 10	Journal Bearings	$3.43 ea	$13.72	

Fig. 2.

number of shipping invoice will be obtained. It will then be an easy matter to locate the particular invoice that shows the article and price desired.

Separate bins are provided in racks on the floor of the storeroom for each article in stock, and are labelled with bin cards (Fig. 5), which provide for marking name of article, and amounts "On Hand," "Received," and "Disbursed." Each time material is placed in the bin or disbursed, the proper notation is made on card by the man in charge. All bin cards are changed monthly, and if the bins are arranged in racks in such a manner as to correspond in relative position to the order items of material are listed in the stock book, it greatly facilitates the taking of monthly inventory.

ner it is easy to locate missing slips when checking up all orders received daily, and avoid the possibility of any becoming lost before entering the accounts.

Each morning the storekeeper checks all order slips for the day previous against the markings shown on the bin cards, as this shows him whether any material has been disbursed without the proper order, which, if not detected, would cause a difference in the accounts when inventory figures are checked against the receipts and disbursements, which is usually done by the accounting department semi-annually. The order slips are then ready for forwarding to the accounting repartment. The storekeeper records the numbers of the order slips sent each day and a receipt is required from the division ac-

RECEIVING BOOK.

N. R. 6213

DATE	CAR NO. ETC.	UNIT	ARTICLES	QUANTITY	ORDER	REQ.	FRT CHGS.
4-25-15	Pass train	no.	5½ x 10 Journal Bearings	4	—	1	Free

Fig. 3.

No material can be drawn from stock unless an order slip (Fig. 6), signed by some one in a supervisory capacity, is presented to the man in charge of supplies, as this is the means of insuring that no material is drawn from stock unless actually required, which prevents waste. Blank order slips are made up in book forms of 100 sheets (50 originals and 50 duplicates) the originals being carbon sheets and perforated for tearing from book, which leaves a copy of each order in the book for future reference. The storekeeper obtains a receipt for each book given to foremen, and at the same time records the serial of numbers the book covers, as it will be noted that each slip is numbered, and in this man-

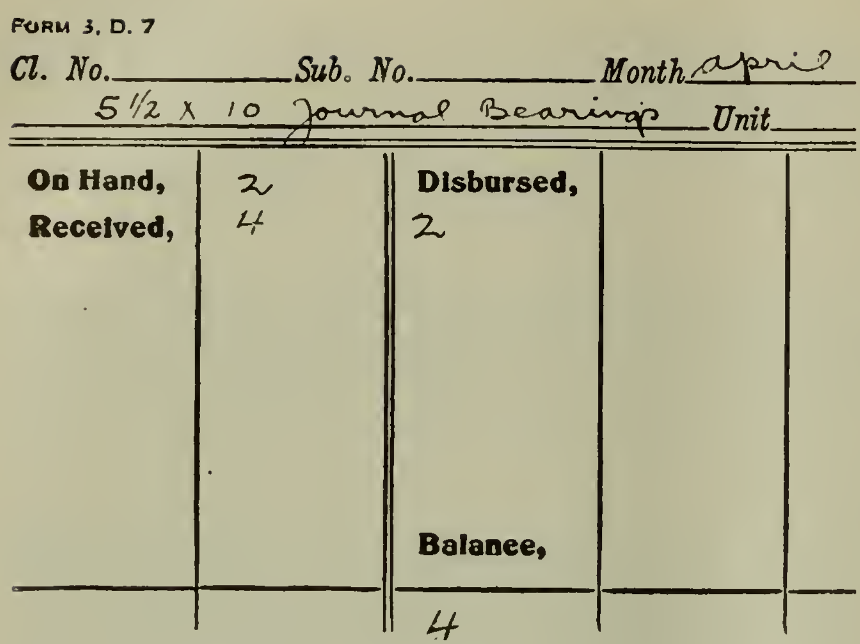
countant for same. This is a further protection against confusion in the accounts that would be occasioned by the loss of order slips. After the inventory has been taken at the end of each month, and bin cards have been changed, the balances as shown on the cards removed are checked against the stock book, and any discrepancies that show up are corrected by again counting the articles actually in the bin. This insures correct inventory being recorded.

In order to protect all heavy material that cannot be placed in the bins, such as air pumps, springs, etc., a special board is arranged on the wall of the storehouse and bin cards covering such heavy material placed thereon

RECORD OF MATERIAL

NAME AND DESCRIPTION OF ARTICLE	PURPOSE FOR WHICH USED	In Units of	JANUARY AMOUNT Due	JANUARY AMOUNT on Hand	JANUARY AMOUNT Ordered	FEBRUARY AMOUNT Due	FEBRUARY AMOUNT on Hand	FEBRUARY AMOUNT Ordered	MARCH AMOUNT Due	MARCH AMOUNT on Hand	MARCH AMOUNT Ordered	APRIL AMOUNT Due	APRIL AMOUNT on Hand	APRIL AMOUNT Ordered	
5½ x 10 Journal Bearings	Loco.	no.										0	2	Reqn #1 4	

Fig. 4.


FORM 3, D. 7

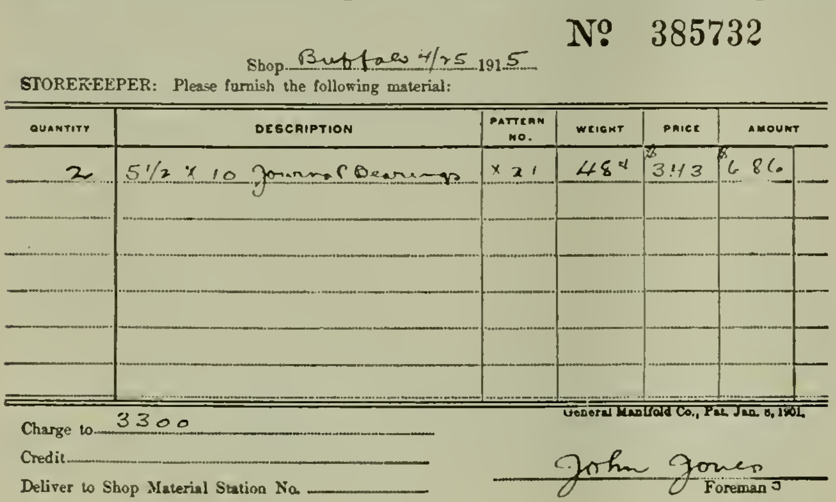
Cl. No.	Sub. No.	Month april
5 1/2 x 10 Journal Bearings		Unit

On Hand,	2	Disbursed,	
Received,	4	2	
		Balance,	
		4	

Fig. 5.

and marked in the same manner as those located on the bins.

In the disbursement of oils, the Bowser system, the workings of which I believe are familiar to all, is the most accurate method of recording. However, at points where this system is not installed, the placing of a thoroughly reliable man in charge of the oil room is the means of obtaining good results. He must be well posted on the general operating conditions in respect to locomotive runs out of his point in order that any excessive orders can be quickly analyzed and correct disbursement made, thereby keeping the consumption down to the minimum consistent with good service. A schedule showing allowances for each engine run on the division is posted


№ 385732

Shop Buffalo 4/25 1915

STOREKEEPER: Please furnish the following material:

QUANTITY	DESCRIPTION	PATTERN NO.	WEIGHT	PRICE	AMOUNT
2	5 1/2 x 10 Journal Bearings	x 21	48#	3 1/3	6 86

General Manifold Co., Pat. Jan. 8, 1901.

Charge to 3300

Credit

Deliver to Shop Material Station No.

John Jones Foreman

Fig. 6.

in the oil room for his information, and must be strictly adhered to.

A careful record is kept on all grease, dope, and waste disbursed either to crews or engine house men, and it is kept in such shape as to enable him to easily furnish the storekeeper with total amounts monthly for the reports. Individual record for each locomotive receiving oil, waste, and grease is maintained in book form, as this facilitates the obtaining of detail information when required. However, at points where this is not possible, on acount of lack of force, the recording of total amounts furnished to each class of service (passenger, freight, work, and switch) daily, will answer all requirements, as details can be obtained, if desired, from order slips on file.

The oil room is equipped with reclaiming apparatus for oil and waste (Fig. 7) and all dope removed from boxes is preserved and cleaned for further use, thereby reducing the cost of lubrication. Maintaining practically

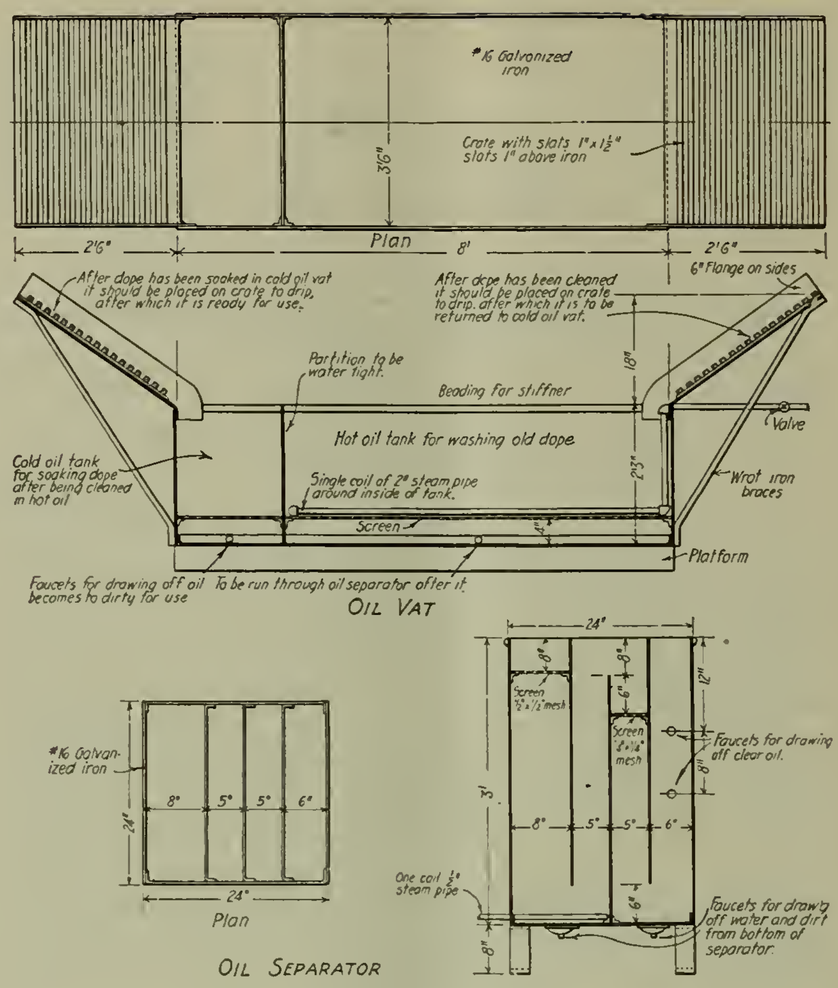


Fig. 7.

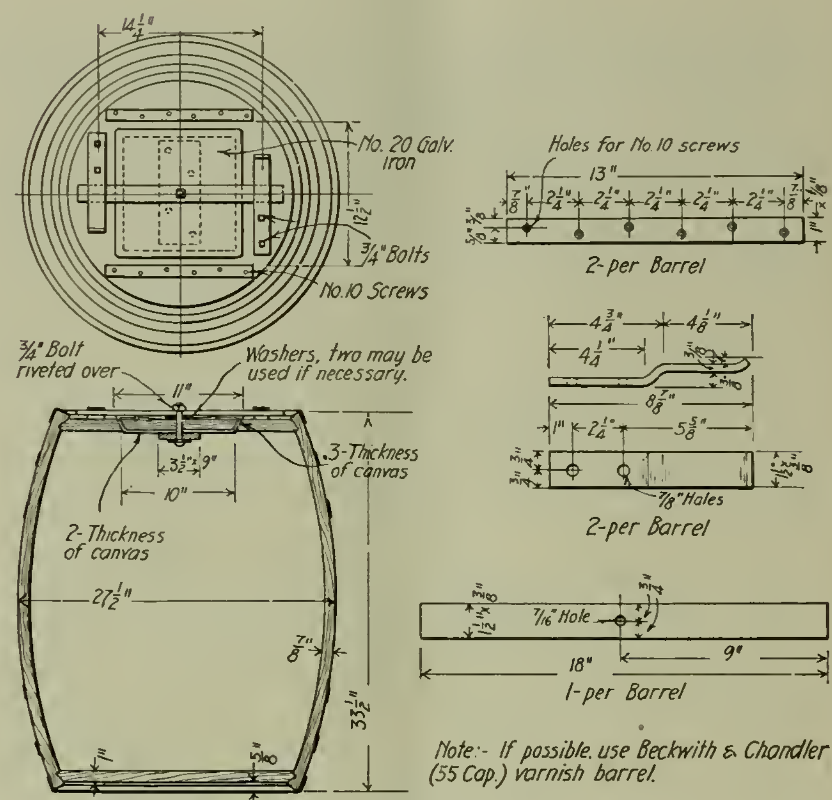


Fig. 8.

the same number of locomotives under the same general conditions during a period of thirty days after this system was installed as compared with thirty days previous to the date of installation, a saving of 395 gallons of oil and 290 pounds of wool waste used for doping purposes was effected.

When dope is returned to the oil room all foreign substances are picked out as far as possible, after which it is placed in the hot oil tank of the oil vat, which contains about 125 gallons of car oil, heated nearly to the boiling point, and by means of a fork moved back and forth until cleaned. It is then placed on grate, as per note shown in Fig. 7, until thoroughly dry, after which it is soaked in the cold oil compartment of the oil vat, which contains about 75 gallons of car oil, from two to three

hours, and then about 15 or 20 minutes before using, it is placed on drain over the cold oil tank, as shown on Fig. 7.

After the oil in the oil vat gets too dirty it is drawn off and placed in the oil separator, also shown in Fig. 7, which removes the grit, and when drawn from this receptacle, can be again used in the hot oil tank of the oil vat, thereby preventing any waste.

This reclaiming equipment takes care of all points on the division and reclaimed dope is shipped to outside points and the old dope returned in barrel as shown in Fig. 8, which is equipped with a special cover that will not allow oil to leak out if turned upside down. The total cost of this barrel is $2.75, which includes $1.00 for the barrel proper and $1.75 for the labor and material to convert. It will last eight to ten months in every day service.

Kerosene and fuel oils are stored in submerged tanks outside the storeroom located near a switch where they are easily accessible for replenishing from tank cars. The oils are drawn through a pipe line by use of Bowser pumps, the fuel oil to the center of the engine house where it is needed for firing up purposes (doing away with the carrying of it from the storeroom), and the kerosene to the oil room, as this is usually disbursed in smaller quantities.

The storekeeping force consists of a storekeeper and three assistants. Days there is one assistant on the floor and one in the oil room, and nights the one assistant takes care of both floor and oil room, as engine house force nights is much smaller than in the daytime, and less oils and other supplies are used. The unloading of heavy material, and the carrying of passenger train shipments to and from the station is, of course, taken care of by laborers from the engine house force.

This organization, under the supervision of the division storekeeper, who has his headquarters at this point, and who, although he has charge of storekeeping matters at engine houses at outside points, spends the greater part of his time in close touch with the conditions at the main terminal, educating his men to thoroughly understand the instructions, will properly take care of the handling of supplies at a point where 75 to 100 locomotives are maintained.

A NOVEL WOOD BORING MACHINE

By W. E. Johnson, Stkpr., C. & N.-W. Ry., New Butler, Wis.

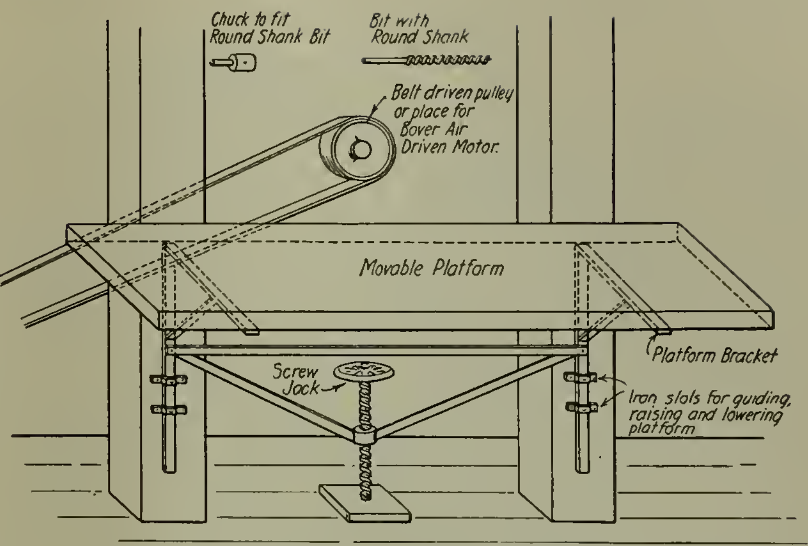
The accompanying illustration shows a novel wood boring machine which is of very practicable use in any car department shop or carpenter shop where speed is desired and also accuracy.

The making of this machine is simplicity itself. Place two timbers, 6 in. square, against the wall in the shop and make solid. These should be placed about four feet apart and squared perpendicular.

For the platform, a good piece of oak lumber, 2"x 12"—6' should be used and to this fasten slots for the braces shown underneath the plank. These slots are for the sliding back and forth of the plank, and should be well greased to insure easy sliding for heavy timbers.

On each post place two slots for sliding the platform up and down with the screw jack as shown. To each of the brackets under the platform rivet braces to the screw jack and reinforce with a brace from one bracket to the other. (The iron used for these brackets to be ⅜"x1½".) This will cause a perfectly horizontal raising and lowering of the entire platform.

On the wall between the posts, place an ordinary wood pulley, and in the center of the shaft, have placed a drill press chuck. See that the chuck is solid in the shaft



A Novel Wood-Boring Machine.

by either riveting it to the shaft or by being made solid with a set screw.

The preparation of the wood bits for the chuck requires only the cutting off of the square part of the shank, leaving only the round part to fit the chuck.

The placing of this machine should be as near a shaft as possible, as the closer it is, the less belting it will require to operate. If it is impossible to run this by a belt, a Boyer air motor could be placed on the wall in the same position as the pulley, providing there are air pipes in the shop.

The two greatest advantages that this machine has are, first, the speed with which it can be run, thereby being a great time saver, as it will bore holes in wood as fast as a man can move the platform back and forth, and second, it insures a perfectly horizontal hole, on account of the platform being made level at the time it was constructed.

A machine of this kind is now in operation in the carpenter shop of Oscar Staats, contractor and builder at New Butler, Wis., and is meeting all requirements.

HOW TO GET HURT.

See if you can oil your machinery while in motion. Watch the boss while you are working on snagging wheel; you are sure to get your knuckles against the stone some day.

Always keep your foot on the treadle of the stamping press and remove the work with your fingers instead of using a stick—lots of people get along with one or two fingers less.

Keep the belt on the tight pulley when setting or removing a die—you are sure that you will accidentally step on the treadle and will live happy ever after with only one arm.

Any old box or shaky stool will do to sit on while working on a stamping press; when it tips over you can hold yourself on the die while the punch comes down.

Use an old piece of gas pipe to support the ram of your hammer while caulking a crack in the impression of your die—you have a chance to knock the pipe out and the undertaker will attend to the rest.

Strike matches and light your pipe wherever you feel like and throw the burning match away—some day you have a chance to do this near an oil or gasoline tank and you will give up that bad habit of smoking.

Don't tell the foreman that there are some bolts lost on your punch press before the night gang starts—they will find that out soon enough when the pieces drop down on their heads.

Never anneal your crane hook—it's great fun to see it snap when carrying a big load and a couple of men right under it.—*American Drop Forger*.

THE DUTIES OF A LOCOMOTIVE ENGINEER *

By W. I. Greene.

An engineer's first and most important duty next to safety and what I consider absolutely necessary to make Safety First an accomplished fact, is harmonious co-operation with every one in any way connected with the operation of the road. The success of the engineer as well as that of every man connected with the movement of trains depends as much on harmony and team work as any other thing I know of. Another equally important duty is punctuality; the way to keep on time is to start on time, be on your engine promptly at the appointed time so you will not have to rush your work and thereby possibly overlook some important thing in the preparation of your engine, which might cause delay to train and perhaps an engine failure. Start right, then your chances are good for a good finish.

Engineers should make a careful inspection and if unable to do so on acount of snow or other causes, report engine to be inspected by round house men; the mechanical authorities could assist by requiring a round house inspection of injectors to know they are in good working order before engines are turned out of the round house: also by devising some system of giving engineer information of work done on engines since previous trip, especially work done on bearings or valves so that they may be given particular attention.

Of course, engine failures will occur in spite of every precaution, but the engineer can help very materially to reduce the number of failures and in this matter, especially in the case of leaky flues, the co-operation of the fireman is absolutely necessary, to avoid an engine failure. An engineer should consider it just as important and be just as particular to know he has two injectors in good working order before leaving round house track as to know he has a clearance of train orders before leaving terminal. I speak particularly of injectors, as this is the most frequent cause of engine delays and failures. Another cause of engine trouble and delay, if not failure, is due to engines not being housed during the winter months, everything is frozen up, oil holes full of ice and it is impossible to get any oil on bearings before starting out, as a result the bearings get hot before they get any oil and require twice the amount of lubricant afterward to keep them from burning up and causing delay or engine failures, and it often happens that even lavish use of oil will not prevent trouble after bearings start to heat, but is simply a waste of oil and offsets to a great extent the saving accomplished on other engines and reduces the general average of miles run to the pint of oil. It is the duty of every engineer to try constantly to improve his oil record to the highest possible point consistent with safety and in this he could be assisted greatly if engines were housed during the winter months.

The all important duty, which, if not properly performed, makes of the engineer a failure, regardless of his other qualifications, is to get over the road. The man who runs an engine with all the possibilities of failure pictured in his mind and trying to provide against them continually is a failure from the start; carrying too much water for fear of what may happen, stopping at every water plug for fear the next one might be dry, always providing for the emergency that so rarely happens, is a practice which does not fit into the railroad game successfully. Make the engine do all the work that she is capable of doing, the company is entitled to that, and the nearer you come to doing it the better engineer you are.

Also the less liable you are to be censured if, in the unforeseen emergency you fail. Do everything you can to advance the train, make but do not exceed the prescribed speed.

The following practice will greatly assist in getting over the road as well as help the fireman to keep required steam pressure and lessen his labor; in starting out the engineer should not use the injector until lever is cut back and the fire has sufficiently burned to hold steam up to required pressure and should always shut off injector when trottle is opened after drifting; he should start his train with the water as high as is possible to carry it without wetting the steam and should maintain the water level at a uniform height by setting the injector to supply just about the amount of water the boiler is using; in this manner a more uniform fire can be carried and the engine will steam better.

After leaving a station he should gradually hook up the engine and get it into the shortest possible cut off as early as schedule time and weight of train will permit. He should at all times carry the lever while working steam as high as consistent with the work to be done. When running on schedule time he should use full time allowed between stations, rather than run faster and stop to kill time; the conductor could assist in this by advising engineer of what stations he expects to stop at. Engineer should also advise conductor at what point he expects to stop for coal and water. In case of anticipated delay or trouble the chief dispatcher should be promptly notified; in case of failures or break downs also advise the mechanical department; they may be able to assist in reducing the delays to your train as well as to other traffic.

Another source of delays on the road is having to take water at designated water tanks, instead of allowing the engineer to use his own judgment.

The secret of successful train handling is in knowing how to control slack action; that is, in knowing how to prevent its running in or out quickly and while this is at times difficult to do, yet by careful study of each train as we find it, it is possible to reduce to a minimum the pulling out of draw bars. Time is a factor which enters largely into the successful control of the slack: slack can not be changed quickly without doing damage to the draft gear. It is therefore well to remember that when handling long trains to give sufficient time for the gradual bunching or stretching of the slack, remembering again that the way to hurry is to go slow when handling these long trains.

An engineer should at all times be ready and willing to instruct his fireman in all things necessary for him to become a successful engineer; some of the more important things he should know is steam expansion and be able to trace the steam from the boiler through the valves and cylinders to the exhaust pot. He should know how to locate pounds and blows, as these are the most frequent troubles. Lessons could be given on these subjects from the engines; would also recommend a technical education on all subjects pertaining to the locomotive for engineers as well as for firemen.

A subject of vital concern to the enginemen and trainmen as well as is the method of administering discipline. The practice of applying actual suspension is I believe as unsatisfactory to the officials as to the men and many of the larger roads have adopted the record suspension plan instead; this plan has been in force on some of our neighboring roads for years and seems to be more satisfactory to both officers and men than that of actual suspension. I do not believe, as some contend, that you must hit a man's pocketbook as the only means to punish him; I have in mind an engineer who recently damaged a car to the amount of forty dollars, he admitted the responsibility, and received a letter from the superin-

*A paper presented before the Missabe Railway Club.

tendent as follows: "Owing to your previous good record we will not even mark your record and hope this will encourage you to continue your previous good work." This man was proud of the letter and showed it to other men and he is certainly encouraged by it to give the best that is in him, as most other men would do. The man who has served actual suspension, who has been injured financially, and whose family may have been made to suffer, naturally becomes a discontented man and a condition that makes this possible should be remedied, and I think a hearty co-operation with our officers would incline them toward the more lenient form of discipline.

An engineer should report defects in track or roadbed, so that they can be repaired promptly, also call attention to fences down or stock straying on track, as this may prevent killing stock or a derailment with possible loss of life.

I believe engineers should also at all times be on the alert for anything that will improve the service and minimize damage to equipment and cases of personal injury; suggestions along these lines should be freely made to the officials.

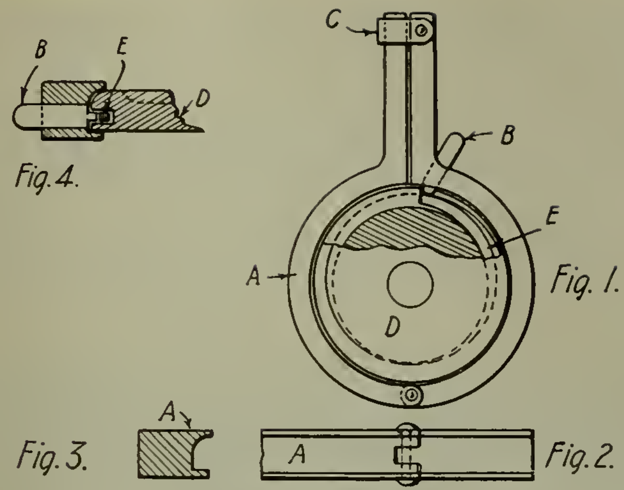
LOOSENING PACKING RINGS.

By J. A. Jesson, Air Brake Fmn., L. & N. R. R., Corbin, Ky.

What is considered about the most annoying job connected with the air brake repair shop is loosening the packing ring of triple valves, etc. The tool shown in the accompanying illustration does the job very efficiently and without any apparent injury to the ring.

Clamp "A" is made in two pieces and hinged together as shown. The inner circumference is bored and grooved to fit the piston "D." The handles are made amply long and a lock clasp "C" is used to lock it. Pin "B" is made of copper and is a tight fit in the hole drilled through the clamp. The end of the pin is shaped up to fit neatly in the piston groove.

In operation the piston is placed in the clamp, pin "B" pushes one end of the piston ring "E" into its groove and engages the other end of the ring, as shown in Fig. 1.



Tool for Loosening Packing Rings.

A cross section of the piston and ring and clamp and pin is shown in Fig. 4. Owing to the close fit of the clamp around the piston and the inward pressure on the ring end being slight, the ring cannot spring out of round.

Considerable care should be exercised, however, in moving a very stubborn ring. After the ring has been loosened a little the piston can be set up in a drill press or lathe, with a fast speed will grind the ring loose in a very short time.

A SERIES OF TESTS of the strength of oxy-acetylene welded joints in steel are being carried on in the materials testing laboratory of the University of Illinois. The joints are welded in the shops of the Oxweld Acetylene Company and are representative of the best welding practice. The tests are being carried on by Messrs. C. A. Brown and G. W. Watts, under the direction of Professor H. F. Moore.

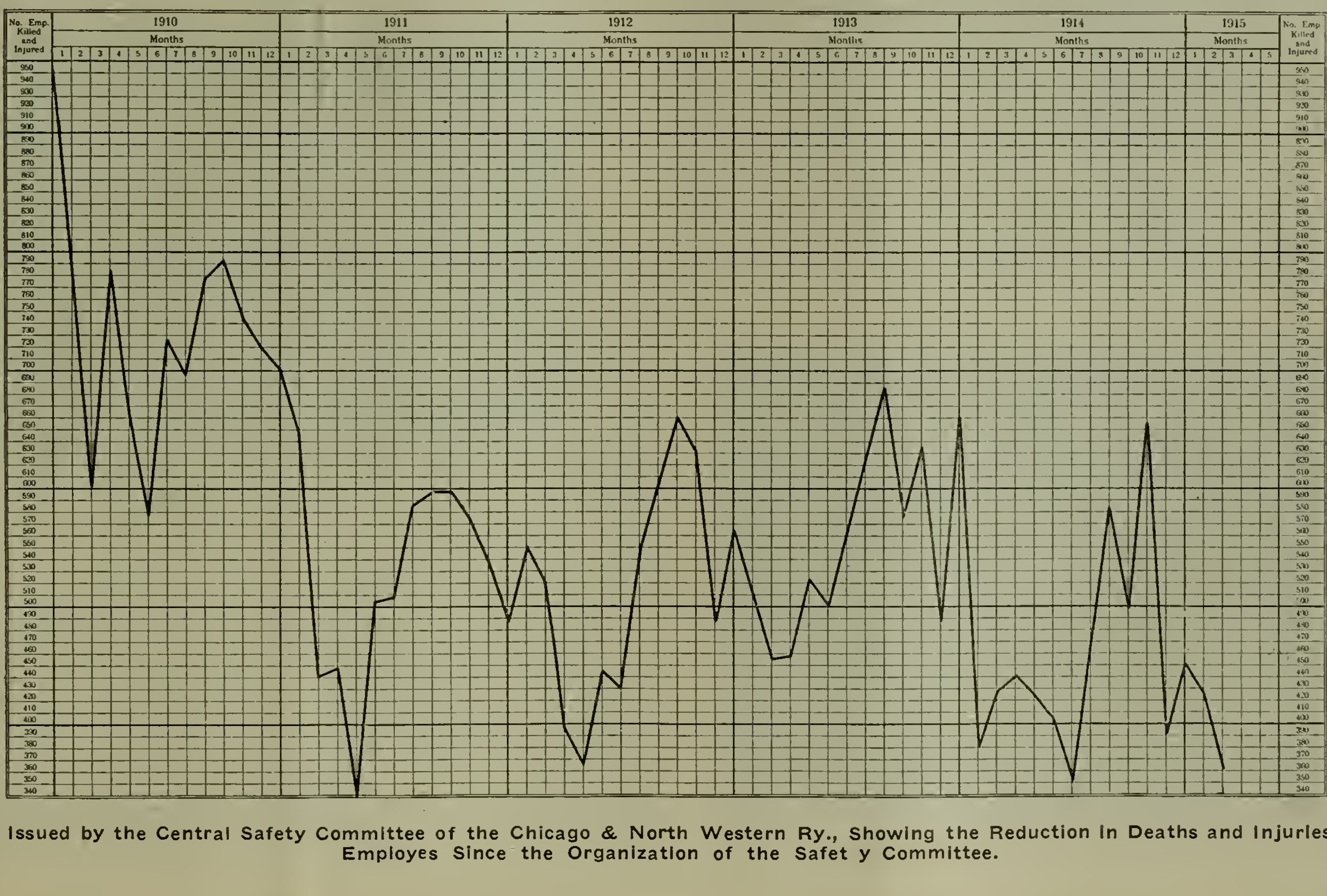


Chart Issued by the Central Safety Committee of the Chicago & North Western Ry., Showing the Reduction in Deaths and Injuries to Its Employes Since the Organization of the Safet y Committee.

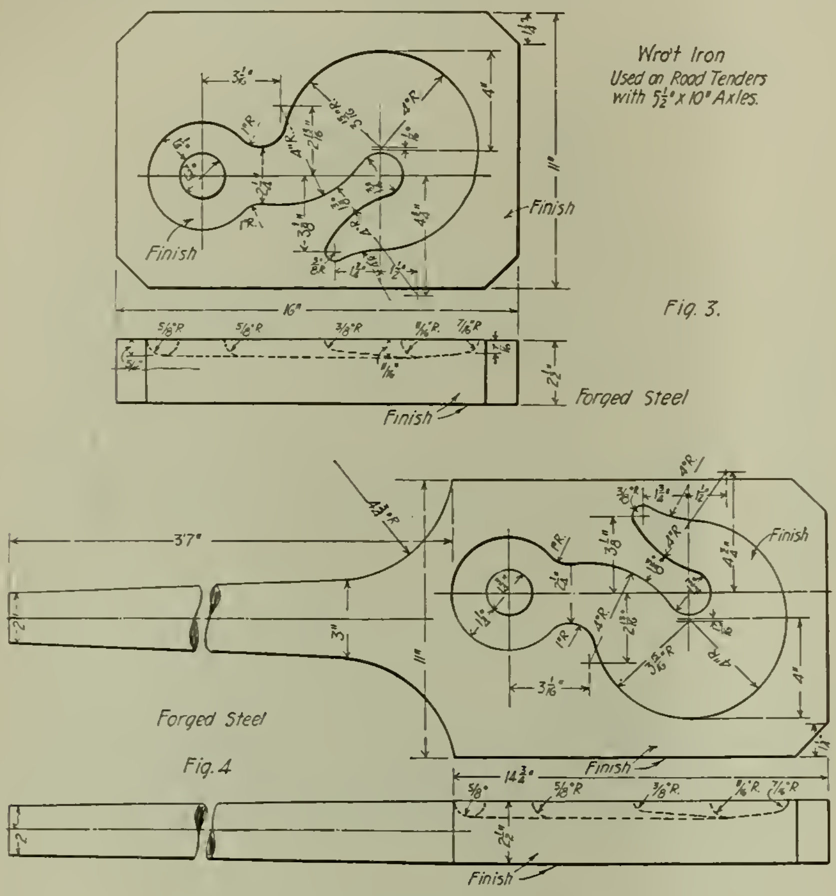
DIES FOR SAFETY CHAIN HOOKS.

By Jos. Grine, Fmn. Blks., N. Y. C. R. R., Depew, N. Y.

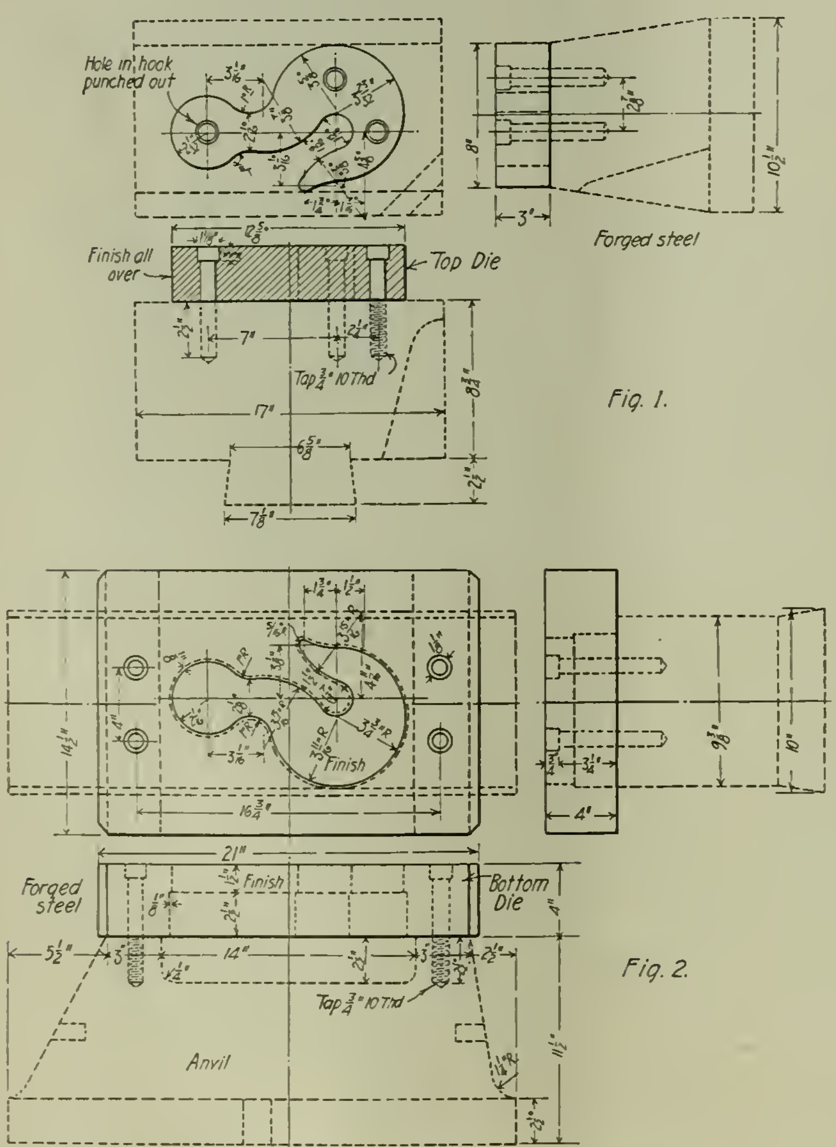
The illustration shows a die for stamping and forming a safety chain hook, as is used on the New York Central Railroad for the rear end of tenders, on all heavy passenger and freight power.

The material used for making this hook is a soft steel 1⅜ in. x 8 in., and the stock is sheared into lengths long enough to make one hook. These pieces are then heated in a furnace, 25 or 30 at a time, or as operator may see fit. The rough blanks are stamped by means of a male and female die under steam hammer, as shown in Figs. 1 and 2. The rough blanks are then taken to a power punch and a hole punched for eye, 1¾ in. in diameter. The blanks are then reheated in furnace and formed to proper shape between dies, same as shown in Fig. 3 and Fig. 4, under a steam hammer. The hook is then complete and ready for service.

This is a simple and easy way, as well as a cheap way of making a safety chain hook of this caliber, where there is no drop hammer in the smith shop. This hook weighs 18 lbs. when complete.



Top Die for Safety Chain Hook.

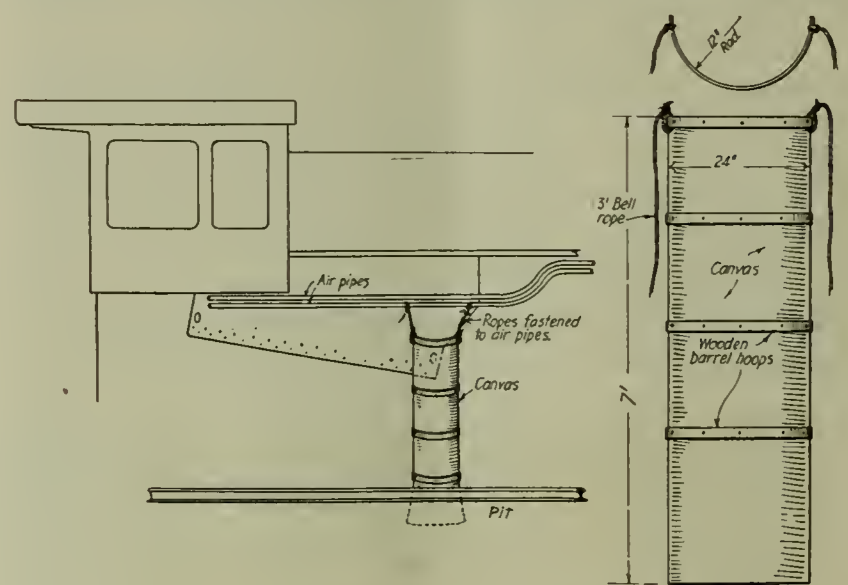


Bottom Die for Safety Chain Hook.

A WASH-OUT DIVERTER

By Charles Markel, Shop Fmn., C. & N.-W. Ry.

All railway shop employees are aware of the inconvenience they are put to on floor side of shop, when boilers are to be washed out, if done during working hours, unless some good protection is provided at the four corner wash-out holes. It is impossible for machinists or others to work about the engine while it is being washed and also damage is done to shop floors and other parts laying around on floor. The illustration shows a very simple and effective diverter made from old cab curtains and barrel hoops. The canvas is held to hoops by wire or twine and the diverter is held in place by rope, opposite each wash-out hole. The hoops hold the canvas in a circular shape and it is of such length that all water out of wash-out hole is diverted to the pit. The top of the diverter is placed about five inches above wash-out hole which allows ample room to get in the rod to work out accumulation of sediment on mud ring and still allows no water to flow on the floor. For cheapness, lightness to handle, and a real diverter this should be tried to be appreciated. The idea originated with boilermaker foreman, Wm. Kerr, of Clinton shops, who deserves credit for it.



Canvas Wash-Out Diverter.

THE ANNUAL MEETING of the National Steel Car Co., of Hamilton, Ont., was held April 24. The annual statement shows a net deficit on operations for the year ending November 30, 1914, of $6,680. The net earning for the previous fiscal year were $236,052. The surplus amounts to $80,785. The directors state that competition last year was very keen, orders in some cases being taken below cost to keep the organization together.

The Micro-Structure of Tool Steel*

The Various Refining Steps in Tool Steel Manufacture and the Defects Which May Creep In at Any Time

By J. V. Emmons,

Metallurgical Engineer, The Cleveland Twist Drill Co., Cleveland, Ohio.

Tool steel may seem at first to be a very special subject of interest to but few. Actually every man is brought into intimate connection with some form of tool steel many times every day. As he rises in the morning, he shaves with a razor of 1.50 per cent carbon steel, made in New York. He files his nails with a file of 1.30 per cent carbon steel, made in Philadelphia. He carves his steak with a knife made in Sheffield of 1.10 per cent carbon steel. The delicate springs and pinions of his watch, all of highly tempered tool steel, guide him to his office on time. So all through the day, tool steel is the servant of man in countless intimate and personal ways.

But, in the work of the engineer, tool steel is even more indispensable. From the time the designer first picks up his drawing instruments until the last rivet is driven in the structure, or the last screw in the machine, hardened and tempered tools play their part. With all this universal use of tool steel, what an elusive and undefinable thing is quality. How many of you have borrowed a mechanic's pet screwdriver? Do you remember how unwilling he was to lend it? He knew that a first-class screwdriver was hard to find and harder to keep. And there is no way to tell before you buy it whether a screwdriver is good or bad. Some time ago the author bought a pocket knife from a large hardware firm in the city. He paid enough for it to insure, as he thought, getting a good knife. After trial, he discovered that one of the blades of the knife was so brittle that one could break large pieces out of it with the thumb nail. Upon returning it, the knife was at once replaced with another

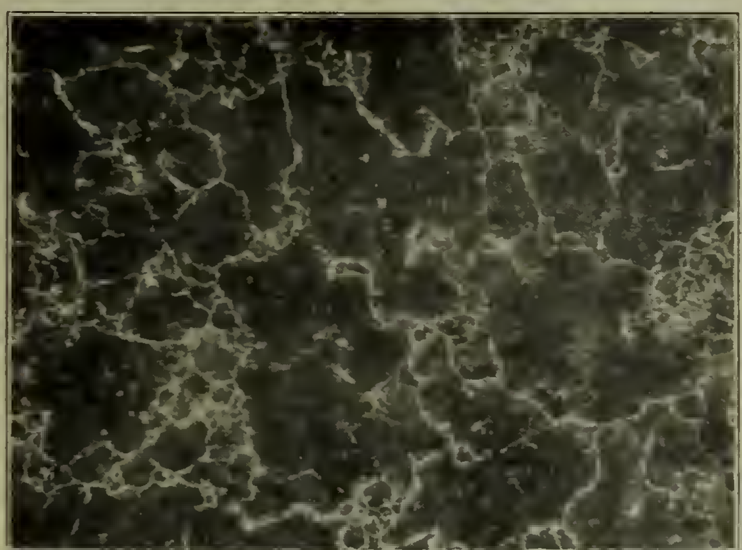


Fig. 1.

similar in appearance, of the same make. One of the blades of this knife was so soft that it could be bent over at right angles without breaking. The knife being replaced a second time, he received a knife that has been the best that he has ever carried.

An examination of the two defective knives revealed that the first had a structure similar to Fig. 1, the long coarse lines of which greatly weaken the steel. The second knife, with the soft blade, had a structure similar to

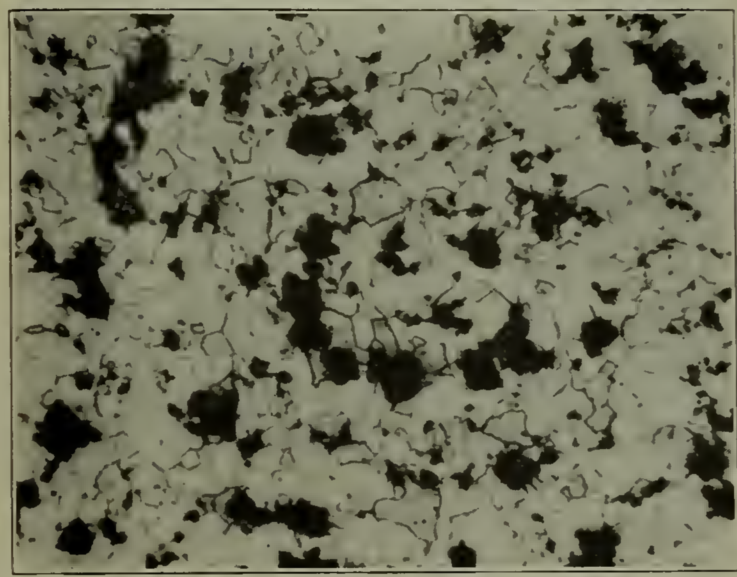


Fig. 2.

Fig. 2, in which the carbon is all in the form of graphite, serving no useful purpose. This structure is almost exactly like that of malleable cast iron, the white grains representing pure iron, the black graphite. The good blade has not been examnied, but it undoubtedly has a structure like Fig. 3, in which the fine uniform structure shows clearly the quality of the material. Yet these three knives, under ordinary examination, appeared exactly the same. Furthermore, the chemical analysis of each is undoubtedly similar, the difference in quality being purely a matter of the different arrangement of the various chemical constituents, or in other words, the structure.

With this introduction, we will proceed to study in detail the micro-structure of tool steel. Tool steel ordinarily contains from 0.60 per cent to 1.75 per cent carbon. The principal structural constituents of annealed tool steel are ferrite, pearlite and cementite.

Ferrite is pure iron and usually appears under the microscope in the form of small hexagonal grains.

Cementite is a carbide of iron, containing three parts of iron to one of carbon. It is remarkable for its great hardness and brittleness and its resistance to attack by

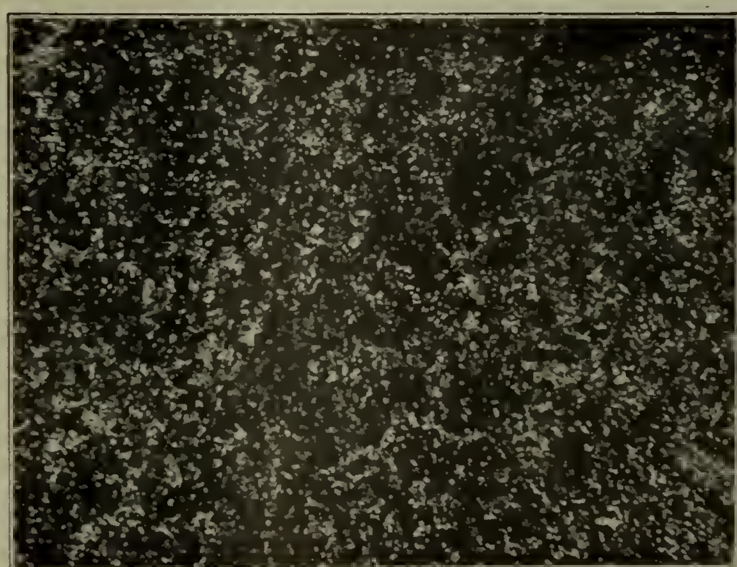


Fig. 3.

* A paper presented before the Cleveland Engineering Society.

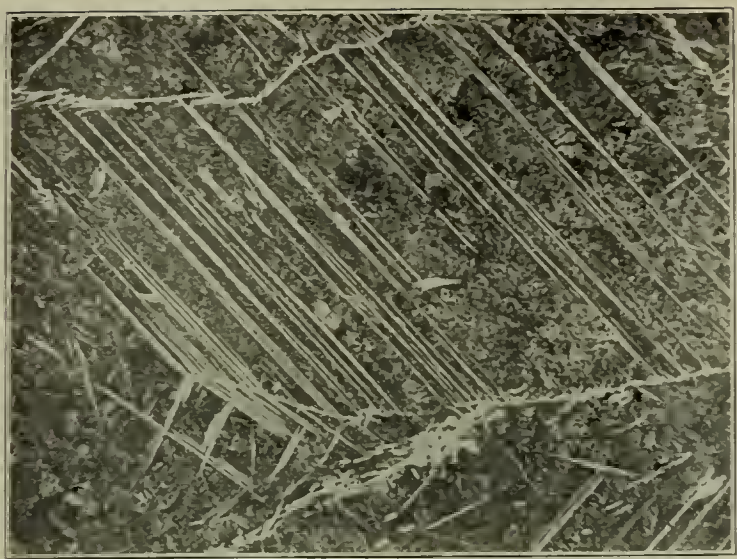


Fig. 4.

acids. It usually appears white under the microscope.

Pearlite is an alloy of iron with 0.84 per cent carbon and always appears to consist of alternate plates of ferrite and cementite. Ferrite, being pure iron, is very soft and weak. Cementite is harder than glass and very brittle. Pearlite, which consists of a mixture of the two, is harder than ferrite and tougher than cementite.

The principal constituents of hardened tool steel are martensite and cementite. The cementite is the same as described above. The martensite is a solution of carbon in iron, which possesses great hardness; its structure is remarkable, consisting of very fine interlacing needles which probably give it its great strength. Hardened and tempered tool steel contains two other constituents, troostite and sorbite, which are softer and tougher than the martensite from which they are derived by tempering, but still much harder than pearlite.

By far the larger part of the tool steel now on the market is made by the crucible process. This, the oldest of all processes of steel making, consists of melting the iron together with carbon in the form of charcoal in a crucible and pouring into an ingot. From this process, crucible steel has often been called "cast steel." Tool steel as it is cast is very brittle and unfit for any purpose. Its structure is coarse, consisting of pearlite with an excess of either ferrite or cementite, depending upon whether the carbon content is below or above 0.84 per cent. The structure of a tool steel ingot containing 1.30 per cent carbon is shown in Fig. 4.

From the starting point, the process of manufacture of a tool steel product is one of refinement of structure. In the steel mill the ingots are first inspected, graded and the pipe in the top broken off and discarded, then reheated and hammered or rolled to a billet. This hot working breaks up the coarse crystals and refines the structure very appreciably. The structure of a high carbon billet is shown in Fig. 5, the grain size of which, while still large, is much superior to that of the ingot as shown in Fig. 4.

After the billets have had the surface imperfections chipped or ground out, they are again reheated and forged

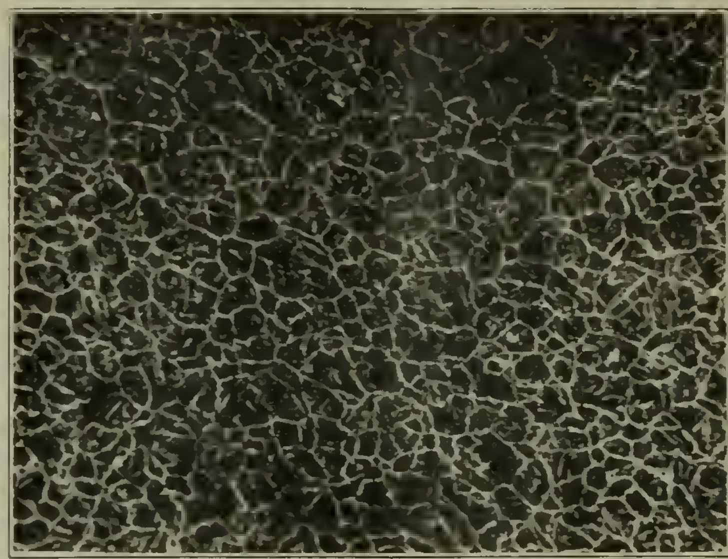


Fig. 6.

or rolled to a block, plate or bar, according to the purpose for which the steel is intended. This working, which is usually at a lower temperature than the previous one, results in a still greater refining of the grain size, as shown in Fig. 6.

The steel is now in the form in which it is received by the tool maker, but before it can be machined, the structure must be still further refined in order to give it softness and put it in proper condition for hardening. This is accomplished by a carefully regulated annealing. This annealing consists of heating the steel to a temperature above its critical point, usually about 1,450 degrees Fahr., and cooling very slowly. This treatment breaks up the coarse network which has been such a prominent feature of the several stages shown before, and substitutes a very fine granular structure like Fig. 7 in its place.

Steel in this condition is now ready for machining and hardening. The machining has, of course, no effect on the structure of the steel. The last stage in the series of refining processes is hardening. The principal structural changes which take place on hardening are the change of pearlite to martensite, the absorption of all ferrite presening, we should not forget that too often the hardener gets the blame for all the mistakes which may have been

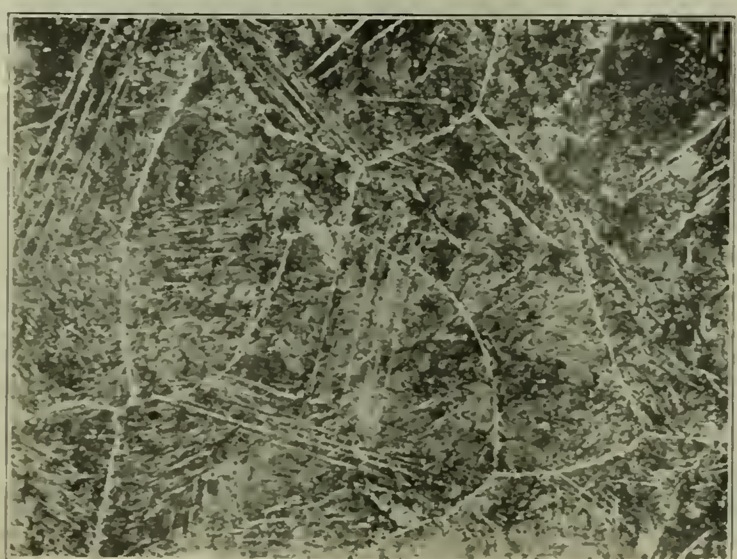


Fig. 5.

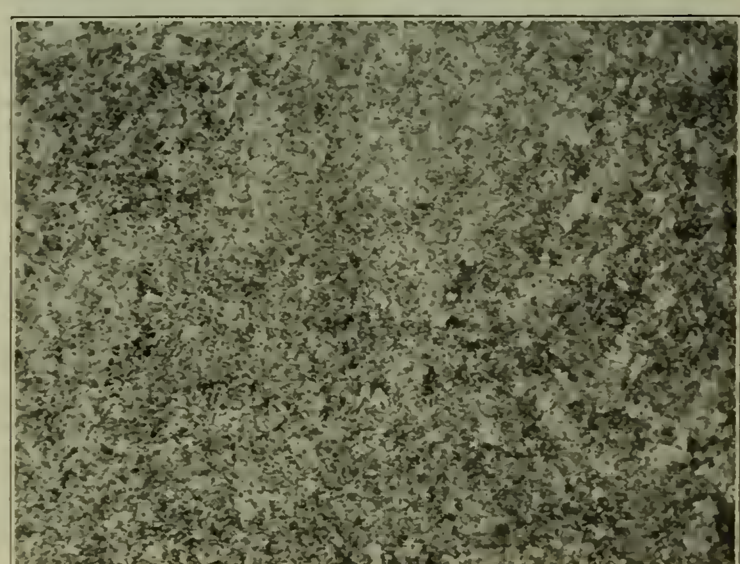


Fig. 7.

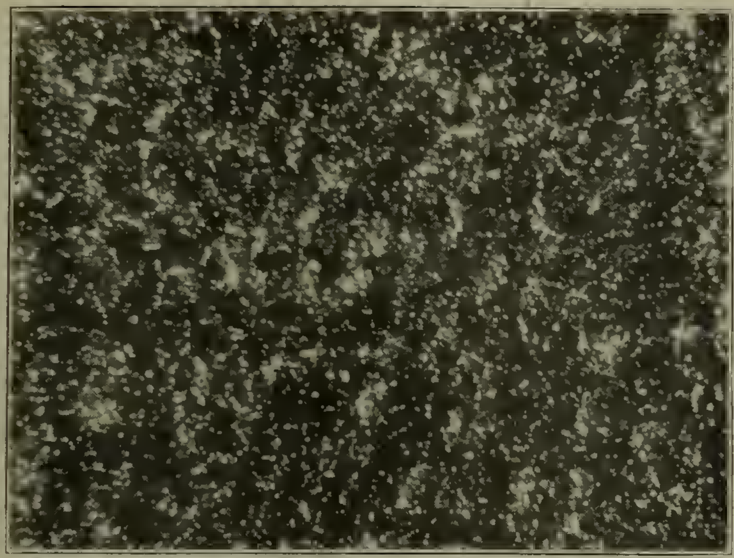


Fig. 8.

ent, the absorption of part of the free cementite and the breaking up of the remainder into smaller sized particles. In the case of a low carbon steel, these changes produce an amorphous mass of martensite in which even the highest powers of the microscope find it difficult to distinguish a structure. In a high carbon steel, the martensite mass is thickly dotted with small particles of cementite, as shown in Fig. 8.

The final heat treatment of drawing the temper results in a change of a portion of the martensite to troostite and sorbite, toughening the tool and reducing its hardness, but not affecting the degree of refinement. This structure is the one which will be present in all high grade tools which have been properly hardened.

In the preceding series of operations for the refining of the structure of tool steel from the ingot to the finished tool, each operation may be assumed to have been perfectly done. Each illustration has been of a perfect piece of steel for the stage to which it had progressed. In the manufacture of tool steel products on a large scale, there is opportunity at every turn for defects to creep into the steel and all unseen by the ordinary eye remain to undo the work of the most skilled mechanics. The microscope has been shown to be by far the most useful means of tracing these hidden flaws to their true source. It also, in many cases, points out the cure or the means of eliminating the harmful condition. Defects in tool steel may be divided into three classes:

(1) Defects which originate in the casting and hot working operations of the steel mill.
(2) Defects resulting from annealing.
(3) Defects resulting from hardening.

Fig. 9.

In the mill, the first structural defect which may occur in tool steel is the formation of a pipe or shrinkage cavity in the center of the ingot. This pipe may be closed over at the top of the ingot and so not being discovered, rolled down to the finished bar. In the absence of proper inspection, it may even progress as far as the hardening operation unsuspected. There it makes its presence known by splitting the tool open along its entire length as soon as it is cooled in the quenching bath.

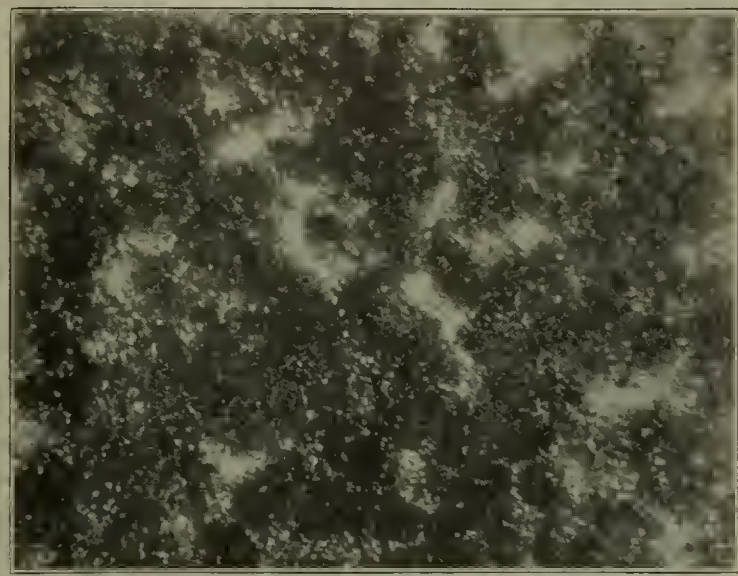


Fig. 10.

Laps, seams and bursts are other defects caused in the mill and are usually visible to the naked eye. Fig. 9 shows a slight seam which has become a still more serious defect through decarbonization.

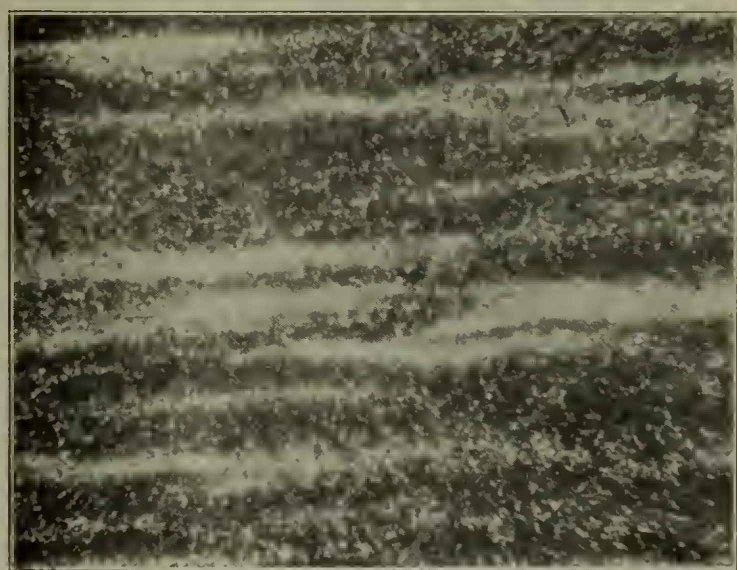


Fig. 11.

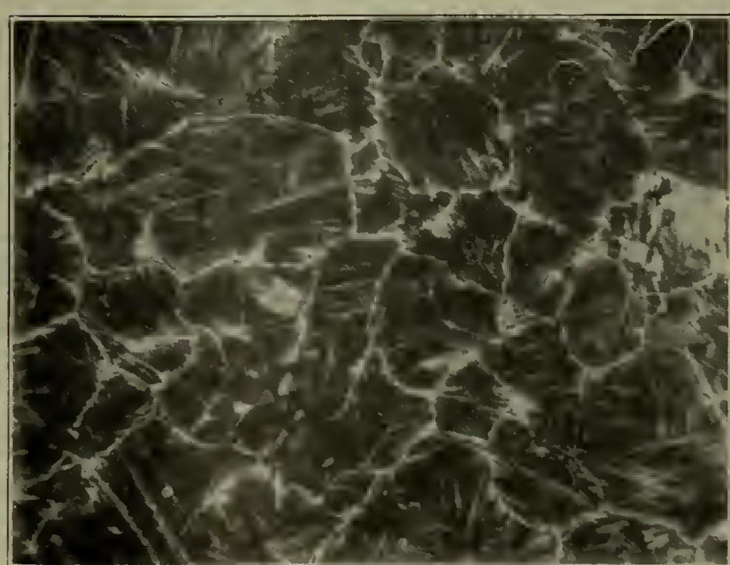


Fig. 12.

Segregation of the carbon is a defect which occurs in the mill, either by prolonged soaking in the reheating furnaces or insufficient hot work. The carbon in the form of cementite instead of being uniformly distributed through the steel, becomes collected in large groups or masses. These masses, as the steel is rolled out in the form of bars, are drawn into long streaks or strings which are a serious form of weakness in the steel. Fig.

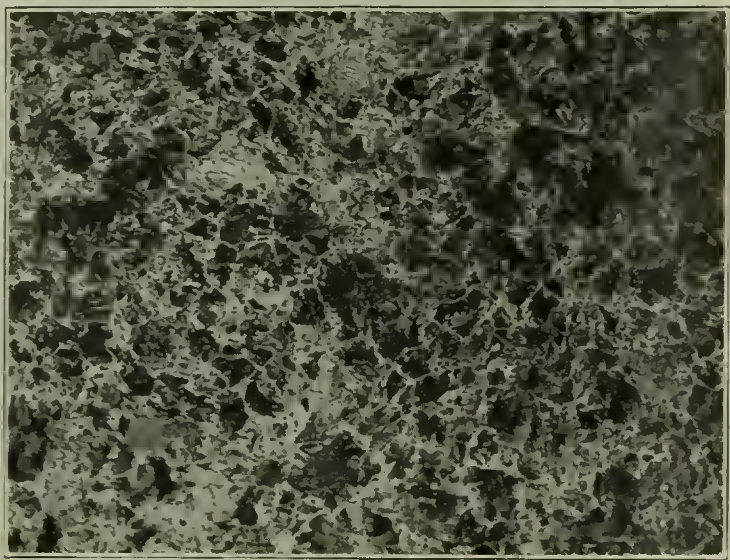


Fig. 13.

10 is a cross section of a bar, showing this segregation; Fig. 11 is a longitudinal section.

Too high temperature of finishing under the rolls or hammers may leave the steel in too coarse a condition to be refined by any ordinary annealing or hardening methods. This is one of the commonest defects in steel as it comes from the mill. Steel in this condition, Fig. 12, will harden with a coarse crystalline fracture and will be liable to firecrack.

The annealing of tool steel is sometimes done by the mill and sometimes by the tool manufacturer, so the defects due to it will be considered separately. Tool steel as it comes to the annealer is usually in the condition shown in Fig. 6. It is necessary that this network be broken up and the steel reduced to a fine uniform structure as is shown in Fig. 7.

If the heat is not sufficiently high, or if the time is not long enough, the coarse structure will be incompletely broken up, with a result like Fig. 13. This would make a tool very likely to chip and of poor wearing quality.

A very serious defect, which is sometimes caused by annealing, is the formation of graphitic carbon. In Fig. 14 is shown a condition, which is produced by a prolonged annealing at low temperatures. The carbon is thrown

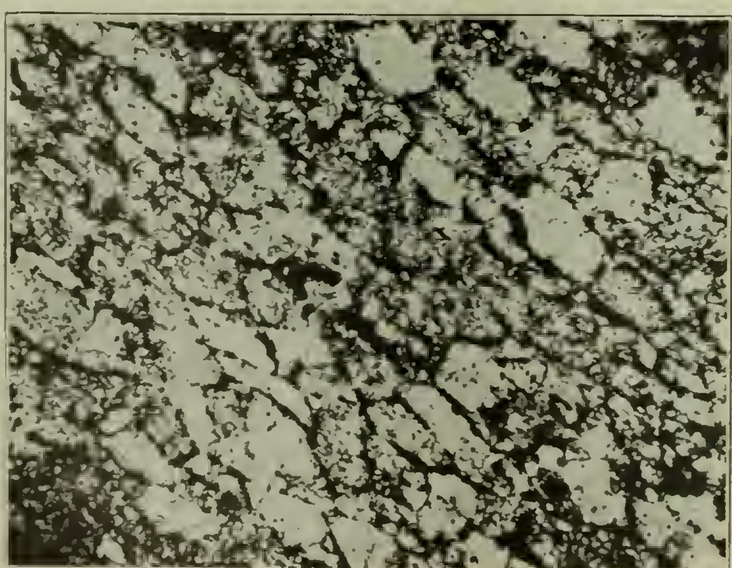


Fig. 14.

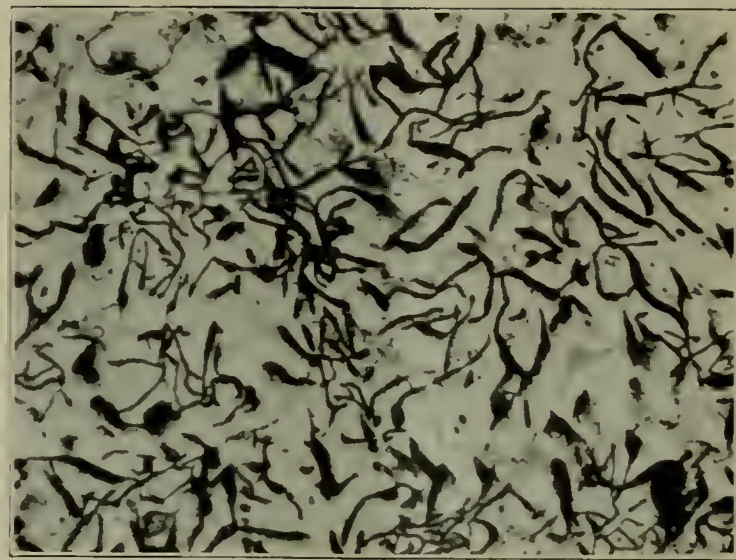


Fig. 15.

entirely out of combination with the iron and assumes the form of graphite.

When this change has taken place, the tool steel is no longer steel, but a very excellent grade of cast iron. Fig. 15 shows for comparison, the structure of ordinary cylinder iron. In many cases the precipitation of graphite is not as complete as this, only a portion of the carbon being thrown out of combination, as in the example of Fig. 16.

In considering the defects which may be due to hard-

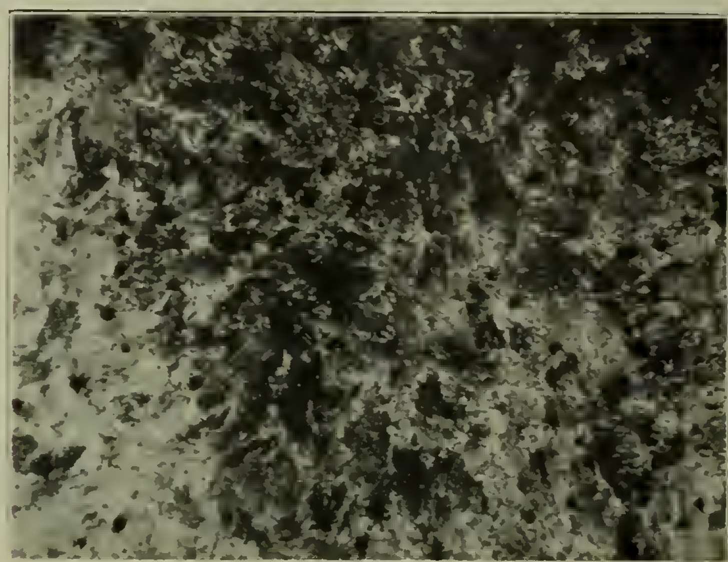


Fig. 16.

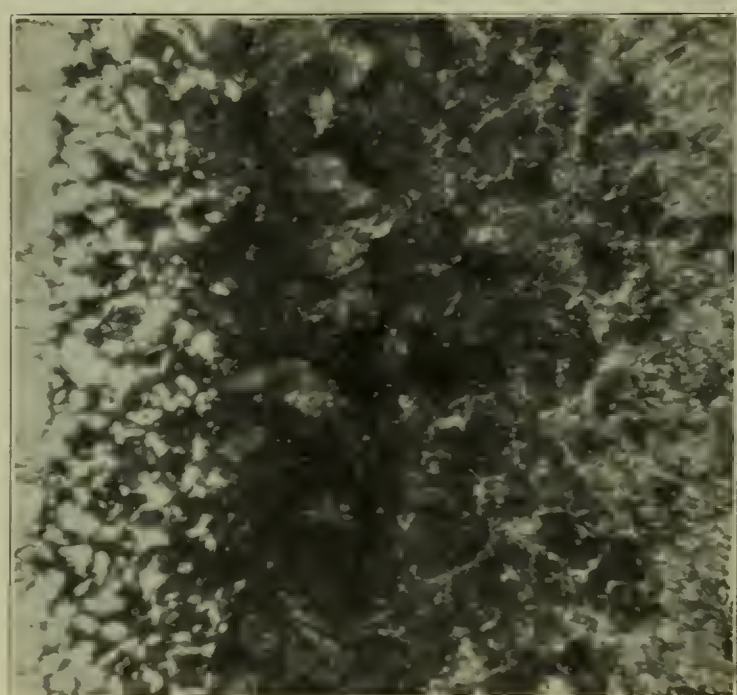


Fig. 17.

made on the steel before he gets it. The most common defect due to hardening is overheat. When a piece of perfectly annealed steel is overheated, the coarse crystalline structure which the steel mill has gone to such great trouble to break up, is again given a chance to grow. The larger this structure is allowed to become, the greater the damage done to the steel. A few minutes' carelessness by a hardener may thus undo many days' work of a careful steelmaker. Underheat in hardening, of course, results in a soft tool with little change of structure. Uneven heating and heating for too short time result in uneven hardening with great danger of firecracking. Heating for too short or too long a time may also cause distortion of the tool.

One of the commonest defects in tool steel has not been classified above, because it may occur at any time the steel is heated above its critical point. This is the decarbonization of the exposed surface, which is commonly known as the bark or skin on tool steel, and is shown in Fig. 17. This defect is present to a greater or less extent on all tool steel and must be removed by machining. It is caused by the exposure of the steel to the air or other oxidizing conditions while heated to a high temperature. The result is the removal of the carbon from the surface and often penetrating to a considerable depth. Taking for example in a 1.25 per cent carbon steel, the cross section of which is shown, the outside of the steel has been reduced to pure iron. Below this is a band of steel of low carbon, then a band of steel of about 0.80 per cent carbon, then the 1.25 per cent carbon of the interior. This bark or decarbonized surface, if not completely removed, will result in soft spots and poor cutting qualities in the hardened tool.

These structural defects are, with a few exceptions, not visible to the naked eye, yet upon their successful prevention depends the quality of the tool. A finished tool containing such a defect might be likened to a bridge, which, perfect in every other detail, is built upon an unsafe pier. The entire structure may be instantly destroyed through the failure of a single member.

In the production of finished tools on a large scale, the most constant vigilance is necessary in both inspection of raw material and regulation of heat treatment, to insure that none but tools with a perfect structure may reach the customer. Even those that make and temper a few tools for their own use, find that inspection of the raw material and regulation of their heat treatment repays many times its cost in the production of tools of increased efficiency. The increased use of the pyrometer in regulating the temperatures of heating has been of immense value in promoting greater accuracy and uniformity. The introduction of the microscope for the inspection of steel and for research will result in still greater improvement. A finished drill or reamer bears no indication on its surface of its cutting qualities, but by the stern test of chemical analysis and under the searching eye of the microscope, its secrets stand revealed.

REVIEWS OF RECENT BOOKS

Oxy-acetylene Welding and Cutting. By C. F. Swingle. Cloth, 7 in. x 4½ in., 190 pages, illustrated. Published by Frederick J. Drake & Co., Chicago. Price, $1.00.

This volume covers the oxy-acetylene process in general and is written to appeal to the operator, being devoid of chemical and technical terms as far as possible. The opening chapter distinguishes the various methods of welding and thereafter the author proceeds to discuss the characteristics of oxygen and acetylene, together with the methods of generating and purifying acetylene gas. Considerable space is given to descriptions and illustrations of welding torches, welding installations and their operation. Only about four pages are given over to a discussion of oxy-acetylene cutting however. The book is especially valuable to those who operate welding outfits or are interested in their operation, for many good points are brought out in non-technical terms. It is rather regrettable that better care was not exercised in the selection of some of the sketches for the illustrations however.

* * *

Heat-Treatment of Steel. By the editors of *Machinery*. Cloth, 6 in. x 9 in.; 278 pages, illustrated. Published by the Industrial Press, 140 Lafayette St., New York. Price $2.50.

This volume covers its subject in a most comprehensive and practical manner, and it is up-to-date in every particular. The authors in compiling the book used information furnished by a large number of men and therefore the contents may be said to very fairly represent the most modern and general practices. The various chapters embrace the heat-treatment and tempering of the various kinds of steel, types of furnaces, case hardening and the testing of hardness. One complete chapter is devoted to the heat-treatment of steel by the electric furnace and another chapter covers new case-hardening methods, including the carbonaceous gas method, a recent development. The subject of the heat-treatment of steel is important and one in which rapid advances are being made from year to year. This book is unqualifiedly recommended as containing the best information on this subject. In addition to its subject matter, the book is well arranged and the illustrations are very clear; a material advantage in assisting the reader who is after information.

* * *

Public Utility Economics. Cloth, 6½ in. x 9 in., 195 pages. Published by the Utilities Publication Committee, 30 Church street, New York.

The West Side Young Men's Christian Association of New York undertook during the years 1913 and 1914 to offer to its members a series of lectures on various public utility problems, and this book is a reprint of the lectures so delivered. The lectures cover all branches of the economics of public utilities and discuss at considerable length the growth of the electric industry, its relation to the investor and municipalities, the progress of the art, and its future. The lecturers are among the men best qualified to speak on the various subjects assigned to them, and include such men as Samuel Insull, W. H. Gardiner, T. C. Martin and others as well qualified in their particular lines. The book is neatly gotten up and the fundamental under-current of thought throughout is the establishment of a better relationship between the public and the utility companies by giving all particulars concerning a thorough understanding of the problems presented. To any one desiring to study the utility problem from a broad-minded standpoint, this book is heartily recommended.

* * *

The Law of Carriers of Goods. By Ralph Marriam. Cloth bound. Published by the La Salle Extension University, Chicago. Price, $1.25.

This book is intended as an elementary treatise of the law relating to common carriers, particularly railroads. It defines the terms common to legal practices and explains and interprets many decisions affecting the railroads in their relationship with each other and with the public. It does not take up to a great extent the matter of the relationship between the railroads and the government as regards the matter and rate and service regulations, but limits itself to the relations of the railroads

to shippers and the general public. It is a valuable book for any one connected with a railroad operating company or to any shipper who finds it desirable to acquaint himself with general railroad law. Placed in the hands of many railroad employes, it could not fail to explain many reasons for rules and regulations made by the operating companies which so frequently appear without reason to one not familiar with the facts.

* * *

The Act to Regulate Commerce. By Henry C. Lust. Cloth bound. Published by the La Salle Extension University, Chicago. Price, $1.75.

While not strictly a textbook, this book is designed primarily to be of assistance to those interested in railway traffic, the theory of freight rates and the practices of the Interstate Commerce Commission. It takes up in considerable detail the scope of the Interstate Commerce Law, explaining the meaning and interpretation of its various sections and in addition to this goes into many subjects of interest to students along these lines, such as discrimination, tariffs, the jurisdiction of the Interstate Commerce Commission and the rules of procedure before the Commission. Appended to the book is a copy of the amended Act to Regulate Commerce and the other acts which may be considered as supplementary to this act.

* * *

Installing Efficiency Methods. By C. E. Knoeppel. Cloth, 7 in. x 10 in., 258 pages, illustrated. Published by the Engineering Magazine, 140 Nassau St., New York. Price $3.00.

The author presented a series of articles on this subject in *The Engineering Magazine* during the year 1914 and this volume contains these articles considerably expanded and revised. As the author says, "he has tried to keep to the tried and proven," realizing that some so-called efficiency engineers have caused the word "efficiency" to be viewed with distrust. Mr. Knoeppel does not harp on the value of efficiency or give mere principles. He gives actual methods for promoting efficiency in a plant and in a number of cases illustrating devices for assisting in the better performance of shop operations. The author himself is a practical man, having come up through the shops. Several chapters are devoted to the planning department and a complete treatise on the bonus plan is given in another chapter. The book is an excellent contribution to the subject of efficiency.

NEW LITERATURE

"Good Furnaces Made Better" is title of a recent publication of the Armstrong Cork Co., Pittsburgh, Pa. It deals with Nonpareil Insulating Brick.

* * *

The Automatic Steam Trap & Specialty Co., Detroit, Mich., has issued a booklet descriptive of the Barton expansion automatic steam trap.

* * *

Bulletin No. 34-M of the Chicago Pneumatic Tool Co., Chicago, is devoted to class "O" steam and power driven compressors.

* * *

The Lagonda Manufacturing Co., of Springfield, Ohio, has just issued a new 12-page catalog entitled "Lagonda Locomotive Arch Tube Cleaners." This catalog covers the subject of scale removal from the arched tubes of locomotive water arch furnaces and describes the specially designed cleaner for this purpose.

* * *

"Faessler Boiler Makers' Tools" is the name of a new catalog just issued by the J. Faessler Mfg. Co., Moberly, Mo. This catalog fully illustrates and describes many types and sizes of boiler tube and superheater flue expanders—sectional and roller—for hand or power operation. It also shows Faessler's flue cutting tools and machines, countersinking tools, etc.

The Important Detail

Square pegs don't fit remarkably well in round holes and every man does best that which he is fitted to do, first by reason of his own preference for that task, and second by reason of the heart and effort he puts into it. The world's achievements have been wrought by men who found their niche, loved it and then worked. And don't overlook that last part. It's only a little detail, of course, like the electric spark in the motor, but the fact remains that it's quite handy in case you desire to make any great progress.—*Drill Chips.*

PERSONALS

Sheridan Bisbee has been appointed fuel supervisor of the *Boston & Albany* with headquarters at Boston, Mass. He will have full charge of all matters pertaining to the use of fuel.

H. H. Vaughan, assistant to the vice president of the *Canadian Pacific,* has been released at his own request from jurisdiction over mechanical matters in order to devote his time to private interests. He will still be retained as consulting engineer.

W. E. Woodhouse has been appointed chief mechanical engineer of the *Canadian Pacific* with headquarters at Montreal, Que.

E. J. Roth has been appointed purchasing agent of the *Chicago, Indianapolis & Louisville* with headquarters at Chicago. He succeeds Fred Davidson and will have jurisdiction over purchases and supplies.

A. A. Masters, for the past three years general foreman of the *Delaware & Hudson* shops at Watervliet, N. Y., has resigned and expects for the present to reside on his farm at Milford, N. Y.

G. A. Mitcham has been appointed roundhouse foreman of the *Denver & Rio Grande* at Ogden, Utah, vice M. C. Reed, resigned.

H. A. Macbeth has been appointed superintendent of motive power of the *New York, Chicago & St. Louis,* succeeding E. A. Miller, deceased. His headquarters are at Cleveland, O.

A. K. Spencer has been appointed master mechanic of the *Ocklawaha Valley* with office at Ocala, Fla. This road was formerly known as the *Ocala Northern.*

OBITUARY

James McGee, master mechanic of the *Lorain, Ashland & Southern* at Ashland, O., died at Lorain on April 6, at the age of 56.

Eli A. Miller, superintendent of motive power of the *New York, Chicago & St. Louis,* died at Cleveland, O., on April 17. Mr. Miller was born May 1, 1847, in Washington county, Pa., and entered the railway service in 1865 as a laborer and helper on the *Cleveland & Pittsburgh R. R.* He then held the following positions: 1866 to 1871, machinist apprentice and machinist on the *Pittsburgh, Cincinnati & St. Louis* at Dennison, Ohio; 1871 to 1873, machinist for the *Louisville & Nashville* at Bowling Green, Ky.; 1873 to 1880, foreman of the *Pittsburgh, Cincinnati & St. Louis* at Dennison, Ohio; 1880 to 1882, roundhouse foreman of this road at Columbus, Ohio; 1882 to 1905, master mechanic of the *New York, Chicago & St. Louis* at Conneaut, Ohio. On May 1, 1905, Mr. Miller was appointed superintendent of motive power of that road.

Drilling Hints

Any hard piece of steel is extremely brittle when cold, and high speed drills should never be put to work in that condition; they work much better when warm, often giving good results when the chips are turned blue by the heat generated. Nothing will "check" a high speed drill quicker than to turn a stream of cold water on it after it has become heated working in a hole. It is equally bad to plunge it in cold water after the point has been heated in grinding. Either of these practices is certain to impair the strength of the drill by starting a number of small checks in it.

A fact often lost sight of, even by experienced users of drills, is that cutting ability and hardness are not the same thing. This is especially true of high speed drills, the apparent hardness of which varies with the composition of the steel and is no indication of the cutting ability. Some of the best high speed tools we have ever tested could be filed so readily that if this were any indication of the work to be expected of them they would be condemned without a working trial. A high speed drill that cannot be filed may, by exercising the greatest care, be made to drill extremely hard material successfully; but for softer materials, or where a large amount of work must be done in a given time, it will be found so brittle as to be worthless.

Numerous tests have proven that the hardness of files varies quite as much as that of other hardened tools, and this is another reason why file tests are unreliable. No drill that files hard or soft should be condemned for that reason alone, but should first be given a drilling test in material of known hardness.

Drills that are properly hardened and pointed and run at moderate speeds and feeds are often condemned on account of breakage when the trouble rightly should be charged to the drilling machine. If there is any spring or lost motion between the upper part of the machine and the table, the drill will not begin to cut until the pressure has taken this up, after which the feed will be practically constant until the point of the drill breaks through. As this happens the resistance to the penetration of the drill is abruptly reduced, and any spring in the parts of the machine will cause the drill to "hog in." The sudden increase in torsional strain which is thus produced frequently causes drills to break.

There is another way in which spring between the parts of the machine sometimes breaks drills. Any movement of the table with reference to the upper part of the machine throws the spindle out of alignment, tending to bend the drill or cramp it in the hole. Practically the same result is produced as when the work moves on the bed of the machine, due to its not being securely fastened down. If the hole is of any depth the drill is almost sure to go, regardless of its temper or the condition of its cutting edges.

The drilling of hard material is facilitated by using turpentine as a cutting compound, and by grinding off the sharp angles of the cutting edges, so as to permit the use of heavy feeds without chipping the cutting edges. This must be done with extreme care and good judgment, however, or the drill will be unfitted for further use. This form of point will also be found efficient in drilling soft material, like brass, when the regular point has a tendency to "hog in" or "grab."

Drills are made to feed to their work easier by thinning the extreme point. This is a delicate operation and requires some skill on the operator's part, but is a decided improvement in hand feed drilling, or when using high speed flat, or flat-twisted, drills with heavy webs.

A PORTABLE POWER PLANT

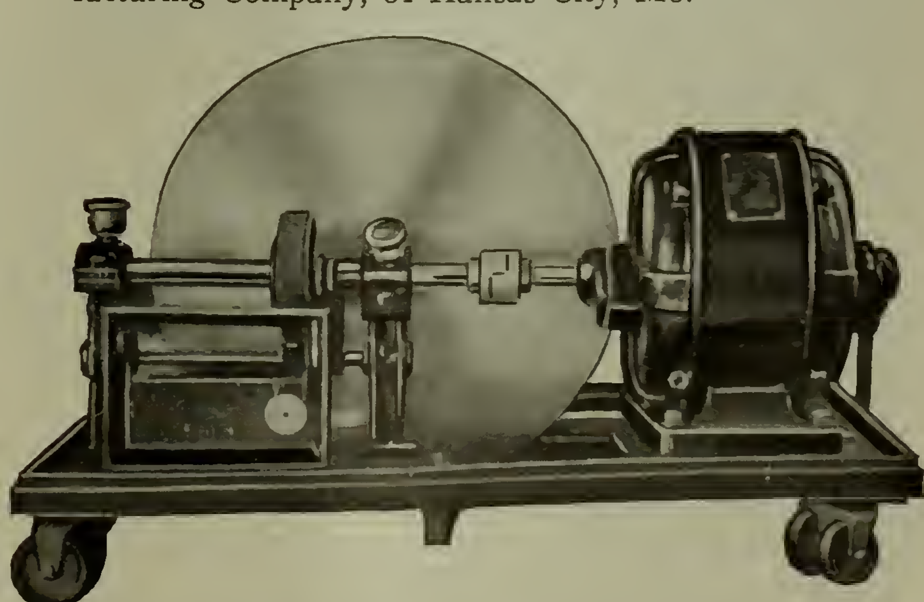
Every machine shop, foundry, manufacturing plant and garage has at some time felt the need of a portable drill and grinder capable of doing really heavy work. The Peerless portable power plant shown in the illustrations combines all the advantages of a drill press and a stationary grinder, and possesses in addition features that make it suitable for many applications where these tools could not be used.

The complete power plant consists of a revolving tool bit socket mounted on the end of a flexible shaft, which is driven by a Westinghouse motor through a variable speed friction disc device. The motor and friction drive are mounted on an iron base to which swivel casters are fitted, and the unit is enclosed in a metal case fitted with handles to facilitate carrying.

Adjustment is provided to take up wear on the driving disc and to vary the contact between the discs for various classes of service. By means of a lever six speeds can be obtained at the tool, and the tool can be stopped without shutting off the current from the motor. By the use of attachments eighteen speeds, ranging from 165 to 3,200 r. p m., can be secured for grinding, drilling and polishing.

The power plant is built in sizes from 1/4 to 1 h. p. The largest size will accommodate drills up to 1 1/2 inches in diameter. Flexible shafts range in length from 5 to 10 feet. All sizes are driven by Westinghouse motors and are furnished for operation on any commercial circuit, either direct or alternating current, by the United Manufacturing Company, of Kansas City, Mo.

Removing Scale from Ammonia Condensing Pipes.



Portable Power Plant with Cover Removed.

THE SELLING SIDE

Alexander Taylor has been promoted to secretary of the Lake Superior Corporation, the Algoma Steel Corporation and subsidiary companies, succeeding Thomas Gibson, who recently became president of the Lake Superior Corporation.

R. H. White, formerly signal engineer of the Chicago Railway Supply Company, Chicago, has joined the selling force of the National Carbon Company, Cleveland, O.

A. J. Poole, formerly superintendent of motive power of the Seaboard Air Line, has become associated with the Galena Signal Oil Company, with headquarters in Atlanta, Ga.

William F. Gillies, in charge of the New York sales branch of the Ingersoll-Rand Company, New York, has been appointed branch manager at Pittsburgh.

Lee H. Parker has been appointed president of the Spray Engineering Company, Boston, Mass.

W. B. Carnes, formerly in charge of the New York office of the Lima Locomotive Corporation, has been appointed western representative, with offices in the McCormick building, Chicago. William T. Middleton succeeds him at the New York office.

Major Luther Stedman Bent, former president of the Pennsylvania Steel Co. and a veteran of the civil war, died at his home in Philadelphia, April 19, at the age of 86 years.

Marvin F. Wood, formerly of Wood & Van Nest, railway supplies, is now located at 30 Church street, New York, representing the Washrite cleaning compound for passenger and baggage cars.

The Bucyrus Company has moved its southern sales office from Birmingham, Ala., to 1105 Hennen building, New Orleans, Louisiana.

The Dearborn Chemical Co., Chicago, has opened an office in Buenos Aires in charge of Edward C. Brown.

The Du Pont Fabrikoid Co., Wilmington, Del., has moved its New York sales office from 90 West street to 1614 Equitable building.

Merrill G. Baker has been appointed assistant general manager of sales of the American Vanadium Co.

J. P. Rapp, steel wheel specialist, has resigned from the Forged Steel Wheel and allied companies, and has been appointed vice-president of the Gulick-Henderson Co., inspecting, consulting and chemical engineer, 30 Church street, New York.

W. B. Carnes, formerly in charge of the New York office of the Lima Locomotive Corporation, has been appointed western representative, with offices in the McCormick building, Chicago.

The Bickwith Railway Fog Signal Co., Fostoria, Ohio, has been incorporated with $100,000 capital stock. The incorporators are C. C. German, H. J. Adams, C. E. Franklin and J. Stephens.

The Bucyrus Co. of South Milwaukee, Wis., has moved its southern sales office from Birmingham to New Orleans, La. E. L. Byron, southern sales manager, who is well known throughout the South, will remain in charge. His office will be 1105 Hennen building.

The Chicago Pneumatic Tool Co., Chicago, has moved its New York office from 50 Church street to 52 Vanderbilt avenue, and its Boston office from 191 High street to 185 Pleasant street.

Edwin S. Jarrett, formerly vice-president of the Foundation Co. of New York, and Ralph H. Chambers, formerly chief engineer and general manager of the same company, have formed the Jarrett-Chambers Co., Inc., contractors, with offices at 30 East Forty-second street, New York.

Charles R. McCormick & Co., manufacturers and cargo shippers of creosoted lumber, ties and piling, with main office at San Francisco, Cal., and mills, creosoting plant and ship yards at St. Helens, Ore, have opened an office at 17 Battery place, New York, with C. E. Bland as New York manager.

The Reliance Equipment Co., Inc., Mobile, Ala., has been incorporated in that city, and has opened offices at 112 North Water street. The company will solicit railway busines in Alabama, Mississippi, Florida and Louisiana, and will specialize in rails, track tools, equipment, waste and general supplies for railway machine shops. The president of the company is James H. Zelnicker, and the vice-president and secretary, William J. Zimmern.

The Canadian Car & Foundry Co. is said to be working on an order for shrapnel and other ammunition for Russia said to amount to $80,000,000, of which $20,000,000 has already been advanced. A part of this business has been let to American companies. The Westinghouse Electric & Manufacturing Co. and the American Rolling Mill Co., Middletown, Ohio, are also said to be working on orders for shrapnel. The Westinghouse Air Brake Co. is reported to have received an order for 1,000,000 shrapnel, valued at $20,000,000, from France.

L. F. Hamilton, in charge of the advertising and specialty department of the National Tube Co., has returned from an extended business trip to the Pacific coast in connection with the exhibit at the Panama-Pacific Exposition. The National Tube Co. exhibit is part of the U. S. Steel Corporation exhibit which is located in the Mines and Matallurgy building and occupies 44,000 square feet—the largest single exhibit at the exposition.

Stockholders of the International Smokeless Powder & Chemical Co., at a special meeting held on April 6, agreed to sell the plant, franchises and patents of the company to the E. I. du Pont de Nemours Co. for $5,760,000.

L. G. Grossman, who for some time has had an office in Washington, D. C., for the general practice of law and the handling of legal business in the District of Columbia, and dealing largely with the securing of patents, has also opened an office at 538 Transportation building, Chicago, and contemplates opening offices in Cincinnati, Ohio, and Kansas City, Mo.

G. Haven Peabody, Chicago, Ill., western representative for the Lima Locomotive Corporation, will represent the Lackawanna Steel Co., in the sale of the products of its new benzol plant, beginning May 1.

M. A. Sherritt, manager of the Philadelphia branch of Manning, Maxwell & Moore, Inc., New York, has resigned to accept the position of vice-president and general manager of the Sherritt & Stoer Co., of Philadelphia, Pa.

J. S. Wright, formerly in the Detroit office of Manning, Maxwell & Moore, Inc., has been appointed manager of the Boston office, succeeding Walter M. Wood, who has resigned because of ill health.

The Chicago Pneumatic Tool Co. announces the removal of two of its branch offices. The New York office, formerly at 50 Church street, is now at 52 Vanderbilt avenue, and the Boston office has been removed from 191 High street to 185 Pleasant street.

George F. Murray has been placed in charge of the Pittsburgh sales office of the Heine Safety Boiler Co., of St. Louis, Mo.

McCord & Co., whose general offices are in the Peoples Gas building, Chicago, have transferred their accounting and purchasing departments to their factory offices at West Pullman, Ill.

The Standard Paint Co. has moved its main office in New York from 100 William street to room 572, Woolworth building.

A. G. Shaver, recently signal engineer of the Rock Island Lines, has opened an office in the Transportation building, Chicago, as consulting electrical and signal engineer.

OBITUARY

William Disston, president of Henry Disston & Sons, Philadelphia, Pa., died suddenly of heart disease on April 5, 1915.

Wilber H. Traver, manager of the mining department of the Chicago Pneumatic Tool Company, died in Houghton, Mich., on April 15.

Railway Master Mechanic

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A Monthly Railway Journal

Devoted to the interests of railway motive power, cars, equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to Bruce V. Crandall.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

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Vol. XXXIX Chicago, June, 1915 No. 6

CONTENTS.

Editorial Management

With this issue of the *Railway Master Mechanic* Mr. Kenneth L. Van Auken assumes editorial charge of this publication. Mr. Van Auken leaves the position of Editor of the *Signal Engineer* and Associate Editor of the *Railway Age Gazette*. He is eminently qualified for this work because of his editorial training and because of his experience as a railroad man.

Never before in the history of the American transportation systems has the railway journal been any more necessary to the railway man than today. This publication has a peculiar and particular field of its own. It deals with problems tremendously important to the railroads, and the greatest care will be taken to insure that the problems which naturally come within the scope of the *Railway Master Mechanic* are treated in a way that will be of practical value to its readers.

BRUCE V. CRANDALL, Publisher.

Both Sides of the Fence

"The *Railway Master Mechanic* is not a paper exclusively for the railway man, nor exclusively for the railway supply man. It is for both of them, and equally so." This statement appeared in the publisher's announcement of the change of ownership of this publication a few months ago.

There has been a sort of an unwritten law among editors and publishers of railway journals and magazines to the effect that a railway paper was published for its subscribers. This perhaps is all right and as it should be, but it has seemed to be taken for granted that only railway men were subscribers to railway publications. The supply man seems to have been overlooked. There is no reason why we should make any division between the railroad man and the railway supply man—a sort of dividing the sheep from the goats. There is no doubt that the railway supply man is very often the goat, but so is the railroad man, for that matter. The fact that a man has something to sell makes him no whit the worse than the man who buys from him, nor does it make him any better, and the fact that a man advertises in a paper is no reason why he should be considered as an outlaw; neither should he be given the publication as a present if he is a particularly large advertiser.

This publication is to take a somewhat new position in that it boldly announces it is published not merely for the benefit of its subscribers, but for the benefit of every man who has to do with railroading, directly or indirectly—who may be interested in the special problems of railroading which naturally belong in its field. Edited in this manner, it should be of the greatest possible benefit to the subscriber, the prospective subscriber, the casual reader, and the advertiser.

There are certain problems to be solved in railroading. The railroad man has his part and the railway supply man his part. The existence of this publication is justified only by being of all possible help and assistance to both the railway supply manufacturer and to the railway man.

Window Openings in Steel Cars

A prominent mechanical official is authority for the following statement: "It looks to me as though the fitting of windows on railway equipment has been somewhat neglected, especially with the advent of steel construction; . . . to attempt to go to the accurate construction in both the sash and the window posts which would be necessary for interchangeability of sash would involve such a considerable expense as to practically prohibit such a move." A mechanical engineer on one of our western systems writes: "I do not think it fair to impose upon the weatherstrip the weaknesses due to irregularity of openings or to sagging of the car."

The difficulty of constructing sash openings to uniformly accurate dimensions is a problem that has risen with the adoption of the steel passenger car. The same small variations in the widths of window openings no doubt were taken as a matter of course in wood construction—and were overcome by dressing down the posts and the sash to a satisfactory fit. Such a solution is out of the question in steel construction where a plane cannot be used to advantage on either the post or the metal sash and resort must be had to other means. More accurate construction is likely to be prohibitively expensive in proportion to the improvement which can be made. Systems of weather proofing are doing all that can reasonably be expected of them when they protect against weather, dust and cinders. Any new device to equalize sash openings must cost less than the more accurate car construction which it will render unnecessary.

Another point to be considered is that while steel cars are not subject to the camber brought about by truss tightening of wood cars, with consequent pinching and refitting of sash, still the steel car settles to some extent, affecting the less elastic fit of metal sash. And when metal sash are removed from a steel car for painting, it would save much time and money if compensating post construction would render them interchangeable to such an extent that careful sorting and replacing would become unnecessary. The problem is rising with increasing frequency and merits consideration.

Railway supplies, No. 16716.—An American consular officer in Russia reports that an engineer in his district desires to place orders for from three to seven locomotive railroad cranes, suitable for a 5-foot gauge, having a lifting capacity of 5 tons. It is stated that these cranes are urgently needed.

The Twentieth Century University

Chaldea had its schools—its universities, Egypt had its temples of learning; the educational work done in Ancient Greece is made use of in modern times. All over this country are scattered great colleges and universities in which many millions of dollars are invested. The best teaching talent of the world is employed within these same buildings. We are apt to look upon their educational work as a finality, to feel that within their four walls is held all that there is of educational work. We have waited for the twentieth century, however, to develop a university along lines quite different and much broader than ever has been known in the past.

If we could only step back and out, outside and away from the hurly-burly rush of life as we find it today, we would suddenly discover that the greatest university in this country, in the sense of giving the greatest amount of knowledge, information and training to the greatest number, is found on the railroads. The educational work done by our great transportation systems is practical, is thorough, and is broadening. No sheepskin is presented to the graduate. No man graduates from the railway service. There never comes to a railroad man that feeling which comes to the student of the college or university, so called, that with the completion of a four years' course he has gained all knowledge and accumulated all facts. Many a boy goes through the four years of college work, is given his degree, and then feels that life holds very little for him.

There is no question but that many a young fellow has been injured by this feeling of finality which a college course gives him. Not so, however, with the college course given by a railroad. A railroad man feels instinctively, if not consciously, that knowledge is progressive, that he learns one thing, but that he may learn two more, and having mastered the two he looks for still further progress. He realizes that what he learns during the months of one year is to be used simply as a stepping stone to the accumulation of more knowledge, leading him always to greater usefulness. The pension system of the railroads does not intimate that a man has graduated from the railway service, but rather that the wearing out of the physical makes it impossible for him to bear his part in the strenuous life lived by everyone active in our modern transportation systems.

One of the most recent programs for still further extending the real university training of railway men is set forth in an announcement from Mr. L. M. Harris, manager of The Frisco-Man, the official publication of the St. Louis & San Francisco R. R., which we quote in full on another page, not alone for its interest as marking the advance being made by the Frisco Lines, but as an illustration of the tendency among all railroads to hasten the time when broadening knowledge shall be not for the few but for the many.

PROGRAM, MASTER MECHANICS' CONVENTION

The program of the forty-eighth annual convention of the American Railway Master Mechanics' Association is given below. The sessions of the convention will be held in the Greek Temple on the Million Dollar Pier, Wednesday, Thursday and Friday, June 9, 10 and 11, 1915, at 9:30 A. M.

WEDNESDAY, JUNE 9

Prayer .... 9:30 A.M. to 9:35 A.M.
Address of President........... 9:35 A.M. to 9:50 A.M.
Intermission .... 9:50 A.M. to 9:55 A.M.
Action on minutes of convention of 1914 .... 9:55 A.M. to 10:00 A.M.
Reports of Secretary and Treasurer ....10:00 A.M. to 10:15 A.M.
Assessment and announcement of dues; appointment of Committees on Correspondence, Resolutions, Nominations, Obituaries, etc.........10:15 A.M. to 10:25 A.M.
Election of Auditing Committee. 10:25 A.M. to 10:30 A.M.
Unfinished Business............10:30 A.M. to 10:35 A.M.
New Business ....10:35 A.M. to 10:45 A.M.
Discussion of Reports on:
Mechanical Stokers...........10:45 A.M. to 11:15 A.M.
Revision of Standards........11:15 A.M. to 11:45 A.M.
Safety Appliances............11:45 A.M. to 12:00 M.
Topical Discussions:
(1) Advantages, if any, of Compounding Superheater Locomotives. (2) Side Bearings on Tenders.
Discussion of Report on:
Smoke Prevention .... 1:00 P.M. to 1:30 P.M.

Adjournment.

THURSDAY, JUNE 10

Discussion of Reports on:
Locomotive Headlights........ 9:30 A.M. to 10:15 A.M.
Design, Construction and Inspection of Locomotive Boilers ....10:15 A.M. to 10:30 A.M.
Standardization of Tinware...10:30 A.M. to 10:45 A.M.
Superheater Locomotives ....10:45 A.M. to 11:30 A.M.
Fuel Economy ....11:30 A.M. to 12:00 M.
Individual Paper on: Variable Exhausts. By Mr. J. Snowden Bell ....12:00 M. to 12:30 P.M.
Topical Discussions:
Tender Derailments, Causes and Remedies. To be opened by Mr. H. T. Bentley...12:30 P.M. to 12:45 P.M.
Road Instructions for Enginemen and Firemen. Crosshead Design. To be opened by Mr. A. R. Ayers. 1:00 P.M. to 1:30 P.M.

Adjournment.

FRIDAY, JUNE 11

Discussion of Reports on:
Joint Meetings with M. C. B. Assn. .... 9:30 A.M. to 9:45 A.M.
Standardization of Tinware... 9:45 A.M. to 10:00 A.M.
Revision of Air Brake and Train Signal Instructions...10:00 A.M. to 10:15 A.M.
Train Resistance and Tonnage Rating ....10:15 A.M. to 10:30 A.M.
Locomotive Counterbalancing..10:30 A.M. to 11:00 A.M.
Maintenance and Operation of Electrical Equipment.......11:00 A.M. to 11:15 A.M.
Forging Specifications........11:15 A.M. to 11:30 A.M.
Boiler Washing ....11:30 A.M. to 11:45 A.M.
Dimensions of Flange and Screw Couplings for Injectors ....11:45 A.M. to 12:00 M.
Subjects ....12:00 M. to 12:05 P.M.
Resolutions, Correspondence, etc. 12:05 P.M. to 12:15 P.M.
Unfinished Business............12:15 P.M. to 12:30 P.M.
Election of Officers, Closing Exercises ....12:30 P.M. to 1:30 P.M.

Adjournment.

PROGRAM, MASTER CAR BUILDERS' CONVENTION

The program of the forty-ninth annual convention of the Master Car Builders' Association is given below. The meetings will be held in the Greek Temple on the Million Dollar Pier, Monday, Tuesday and Wednesday, June 14, 15 and 16, 1915, at 9:30 A. M.

MONDAY, JUNE 14

Address by the President....... 9:30 A.M. to 10:30 A.M.
Reading of the Minutes of the Last Meeting ....10:30 A.M. to 10:35 A.M.
Report of Secretary and Treasurer ....10:35 A.M. to 10:50 A.M.
Assessment and announcement of annual dues; appointment of Committees on Correspondence, Resolutions, Obituaries, etc. ....10:50 A.M. TO 11.00 A.M.
Election of Auditing Committees. 11:00 A.M. to 11:05 A.M.
Unfinished Business ....11:05 A.M. to 11:10 A.M.
New Business ....11:10 A.M. to 11:20 A.M.
Discussion of Reports on:
Nominations ....11:20 A.M. to 11:30 A.M.
Revision of Standards and Recommended Practice ....11:30 A.M. to 12:00 M.
Train Brake and Signal Equipment ....12:00 M. to 12:30 P.M.
Brake Shoe and Brake Beam Equipment ....12:30 P.M. to 1:00 P.M.
Car Wheels .... 1:00 P.M. to 1:30 P.M.

Adjournment.

MONDAY, JUNE 14

The Executive Committee decided that it would be best to have a session devoted exclusively to a discussion of the revision of the Rules of Interchange and that it form a part of the Proceedings.

At this session the following reports of committees will be considered: 1, Arbitration Committee; 2, revision of prices for labor and material; 3, settlement prices for reinforced wooden cars; 4, compensation for car repairs.

TUESDAY, JUNE 15

Discussion of Reports on:
Couplers .... 9:30 A.M. to 10:30 A.M.
Safety Appliances ....10:30 A.M. to 10:45 A.M.
Rules for Loading Materials..10:45 A.M. to 11:00 A.M.
Overhead Inspection ....11:00 A.M. to 11:10 A.M.
Interline Inspection ....11:10 A.M. to 11:25 A.M.
Car Construction ....11:25 A.M. to 12:00 M.
Specifications and Tests for Materials ....12:00 M. to 12:30 P.M.

Tank Cars ....12:30 P.M. to 12:45 P.M.
Individual Paper—What Is the Value of a Patent? By Mr. Paul Synnestvedt......12:45 P.M. to 1:30 P.M.
Adjournment.

WEDNESDAY, JUNE 16

Discussion of Reports on:
Train Lighting and Equipment. 9:30 A.M. to 10:00 A.M.
Car Trucks ....10:00 A.M. to 10:30 A.M.
Draft Gear ....10:30 A.M. to 11:00 A.M.
Joint Meeting with A. R. M. M. Assn. ....11:00 A.M. to 11:15 A.M.
Topical Discussion:
Air Brake Maintenance......11:15 A.M. to 11:30 A.M.
Unfinished business; Reports of Committees on Correspondence, Resolutions and such other committees as may be named during the convention ....11:30 A.M. TO 11:45 A.M.
Election of Officers..........11:45 A.M. to 1:30 P.M.
Adjournment.

THROUGH THE SMOKE OF THE ROUNDHOUSE

The relentless sun of a July morning was fast climbing to the pinnacle of high noon, and poured its ceaseless torrent of fiery rays upon the roundhouse and adjoining buildings. The shiny back of old 426 shot forth quivering reflections of the torrid heat as she rested on the turntable like a huge black turtle basking in the sun. Clouds of whirling steam were wafted from an engine which was blowing off, and the time-scarred buildings echoed back a medley of discordant sounds. A call boy burst from one of the smoke-laden doorways at full speed, leaped over the battered remains of an old headlight, and vanished around the corner of the oil house just in time to escape a slashing blow from a pair of oil-soaked overalls in the grimy paws of old Jack, a weather beaten knight of the throttle.

"What's the matter, Jack?" asked a husky young smoke, who was in line for promotion to the right-hand side of the cab. Old Jack composed himself, wiped the sweat from his grimy face and held up an evil-smelling briar pipe for inspection. "I've got good reason to be mad," he bellowed. "I just got in off the long haul with 987. She's been leaking like a sieve and it nearly pulled our corks to keep steam enough in her to take us in. Well, we got here all right, and no sooner did I get my report in than along comes that cotton-topped insect with orders to take out the Red Ball. Now, naturally out of force of habit, I cursed everybody in general, the insect included. The slab-sided brat gets peeved, and when I laid my pipe down and was signing up, he grabs a squirt can and gives the pipe a shot of oil. Now, isn't that enough to destroy the human side of a man's nature?" Old Jack shuffled off and sat down upon an old pilot coupler which was half buried in the cinders near the roundhouse wall. He was still in the heat of rage, but seemed relieved after his talk with the young smoke. Old 426 pulled away from the turntable, shining in the sunlight like a polished black gun barrel. Her new compound air pump was beating industriously and the reverberating hum of the blower seemed to transmit its pulsations to the surrounding scenery.

Long strings of washing fluttered from their clothes lines in the rear of the line of sun-baked cottages across the tracks where the tub and washboard worked overtime, while the Knights of Scoop and Throttle sought their hard-earned rest. From the hot and dusty freight yards came the crash and roar of switching cars and the staccato puffing of the six-wheelers as they rattled over the rough frogs and side tracks. The roar of a train floated in from the main line as No. 17 neared the west end crossing and whistled for the board. As the heavy train lumbered over the crossing it proved to be a double-header, but upon close inspection it was seen that the second engine was a cripple. The engine change was quickly made while the cripple was pushed into the roundhouse, and Joe Reilly hurried in to make the report of his engine failure. "What's the matter with the old kettle now, Joe?" asked old man Smith, the roundhouse

"Just in Time to Escape a Slashing Blow."

foreman. "Slipped both eccentrics at Fernwood Junction and came near dying on the crossing," said Joe, as he mopped his face vigorously with a red bandana. "It was just bull-headed luck that saved us from blockading a foreign road. I thought the old tub was going lame when we were getting close to the crossing and as the block was against us I had to stop. And when we got the board she gave a few shots and then died with her pilot about 5 ft. from the crossing."

"Why didn't you fix it, Joe?" asked a small bull-necked machinist who had been looking intently between the spokes of the second driver. Joe's eyes contracted with a murderous squint as he sized up the diminutive engine doctor. "Why didn't you white-eyed nut splitters set those eccentrics so they wouldn't slip?" he hissed. The nut splitter grinned as he bit off a chew of "star" and winked at old man Smith. "It's too bad, Joe, but it can't be helped now," said the nut splitter. "I'm grieved to think that a man of your ability and 15 years of experience on the right-hand side of the cab, has neglected to learn how to make an emergency eccentric setting." The last words of this sentence were spoken as he scampered to the other side of the engine and ducked a flying dinner pail which crashed against the heater pipes upon the wall.

Reilly had burst into a spasm of rage and shook away the pacifying grasp of old man Smith. "Let me at him,"

he roared. "He's added insult to injury by kidding me about this, and I won't stand for it." "I'll mail you a copy of Break-Down Rules by Moses Cohen," said the nut splitter as he poked his head around the corner of the tender. "There he is again," bellowed Reilly, as he looked for something to throw at his tormentor, who grinned diabolically. The enraged Reilly looked as if he needed a pop valve with which to release his pent up anger. "Don't talk to me," he shouted. "I don't want to look at you. I wouldn't speak to you if I met you in h—l carrying a glass of ice water in your hand. When you croak I hope they give you a job setting red-hot eccentrics bare-handed." Reilly was too mad to say more and shuffled outside to seek consolation from old Jack, who blew out his oil-soaked pipe with live steam and was filling it up again with clippings.

"Well, kid, how's the world using you?" Old Jack thus greeted the dejected Reilly as he sat down in the shade of the wall beside the veteran. "Rotten," said Joe; "it was bad enough to get stuck with slipping eccentrics and have to get pulled in, but when that gazelle-eyed nut splitter kids me for not being able to set them, its more than I can stand. The boilermakers will be telling me that the mud ring oiler is leaking near the niggerhead one of these days I suppose."

"Ducked a Flying Dinner Pail."

"Aw shucks," said Old Jack, "Don't take it to heart so much. When I was young at the game like you are, I had the same thing happen to me, and more than once at that. Don't be afraid of a little kidding, and if the boilermakers start it, tell 'em their dope doesn't count because they're only machinists with their brains knocked out. If the machinists kid you, tell 'em you've got a hundred per cent discount on their opinions, for they're only watch makers gone wrong; don't let 'em get your goat so easy."

"I know that I flew off the handle too quick, Jack," said Reilly as he kicked an old piece of oil-soaked waste aside, "but this valve-setting business has got my Nanny good and proper. What would you have done if you had been in my place today when she went dead on the line?" Old Jack gazed intently into the bowl of his pipe and puffed thoughtfully. "I would have made an emergency setting," he said. "If I found that I had slipped both eccentrics on one side, I'd put her on forward dead center, then put the go-ahead eccentric above the axle and the back-up eccentric below the axle. Then I'd put the lever in full gear forward, open up the cylinder cocks, and give her a little steam. Then I'd advance the top eccentric till the front cylinder cock showed steam. Do you get me, kid?" asked Old Jack. Reilly nodded, and Jack continued: "Then the thing to do is to put the lever in full gear back and move the bottom eccentric toward the crank pin until steam again blows from the forward cock, then lock up the eccentric and pull the pin."

Reilly, who had by this time cooled off entirely, gazed in admiration at the veteran Jack, who shook the ashes from his beloved pipe and stretched himself with a twinkle in his eye. "Well, kid, do you think you've got it all stowed away for future use?" he grunted. "Say, Jack," said the much relieved Reilly, who had just made a rough sketch of a Stephenson link motion on the back of a card, "there's nobody going to get my goat any more, not even the white-eyed nut splitter with his book of Cohen's break-down rules." "Stick to it, kid," said Old Jack. "There's lots to learn about the locomotive and its diseases, and it takes time to learn it, for a lot of the knowledge comes from hard knocks." "I guess I'll go over to the house and get a little bite to eat before I take out the Red Ball this afternoon." "Perhaps I kept you from getting there sooner, by telling my troubles to you, Jack," said Reilly. The old man shook his head. "No, kid, I would have stayed here anyway," he said. "I've got a comfortable home, all right, and since the girl has grown up and takes care of the house, she always remembers her old dad when he comes in off the run. I like to be home with the grandchildren, but there are times when that little cottage and garden of mine bring back sad recollections of bygone days. We planted that little garden, the wife and I, and every inch of it was dear to her, and since that bitter day when I laid her to rest, I can forget the sad memories when I wander around the engines and hear the scrapping of you youngsters Through the Smoke of the Roundhouse.

"I Like to Be Home with the Grandchildren."

Meeting of Air Brake Association

The Twenty-Second Annual Convention Held at Chicago Brings Out Some Excellent Papers

The twenty-second annual convention of the Air Brake Association was held at the Hotel Sherman, Chicago, on May 4, 5, 6 and 7, 1915, the sessions being presided over by the president, L. H. Albers, of the New York Central. An invocation was offered at the opening of the convention by Rev. M. J. Magor, after which the members and friends of the association listened to the address of welcome by Robert Quayle, general superintendent of motive power and rolling stock of the Chicago & North Western. Mr. Quayle's address was delivered in his customary vigorous and forceful manner, and in it he emphasized the important requirements of an air-brake man, making special reference to the maintenance of a proper attitude toward his work and fellow employees.

In the president's annual address Mr. Albers advocated that brake equipment be cleaned less frequently, thereby decreasing an unnecessary expense. He stated that tests made on his road indicated that the periods between cleanings could be increased without in any way decreasing efficiency. Mr. Albers also advocated the adoption of a standard triple valve.

The reports of the secretary and treasurer showed that the association had 1,119 members, 74 new men having been added during the past year. The cash balance on hand was $427.91, which was the lowest balance reported in years, and the report showed that this was due to the financial difficulties in railway circles during the past year, which was reflected among the individual members of the association. The past president's badge was conferred on W. J. Hatch, and as a special mark of appreciation a loving cup was presented to S. J. Kidder, of the Westinghouse Air Brake Co., who has long been identified with the association. The papers and reports were then presented.

ELIMINATION OF MOISTURE FROM TRAINS AND YARD TESTING PLANTS

The report on this subject was prepared by Mark Purcell and M. F. Gannon, and read by Mr. Purcell, who, in opening, dwelt briefly on the relative humidity of air and its properties, and emphasized the importance of providing "dry air" at storage yard compressor plants. Then followed a description of an air cooling plant which was installed in the fall of 1913 in the Mott Haven yard of the New York Central, and which is said to have been in successful operation since. Briefly, this plant consists of 8,018 feet of ¾ in. pipe made up into 48 sections. The pipe is placed vertically, with headers at the top and bottom for each of the 48 sections. In conclusion, attention was called to the lack of adequate air cooling equipment in locomotive compression systems.

DISCUSSION.

The discussion was confined largely to the question of eliminating moisture on locomotives, one of the points brought out being that road conditions have a great deal to do with the precipitation of moisture. A representative of the Santa Fe stated that this road has a system whereby the hostler is required to open all drain cocks on engines at terminals. The number of reservoirs and the amount of piping between each was gone into thoroughly, and from the opinions expressed it was apparent that there is a wide difference in the practices of various roads in this regard. A majority favored the use of two reservoirs, and it appeared that the average amount of piping between the compressor and the first main reservoir was about 25 ft., but instances of 40 ft. and 85 ft. were reported. The Denver & Rio Grande experienced trouble with freezing in the train line between the tank and the first car, and the enginemen are now required to drain the engine cocks each day. The interest shown in this subject was so general that the committee was increased to five and continued for another year, with the suggestion that it make tests in actual service on locomotives under all conditions.

IMPROVING THE OPERATION OF THE PNEUMATIC SIGNAL DEVICE

L. N. Armstrong and H. L. Sandhas prepared the report on this subject, stating among other things that "possibly the largest factor in the correct operation of the signal device is maintenance." Leakage causes false signals to be transmitted which destroy the confidence of the crew in the signal system. The committee also stated its belief that the electro-pneumatic signal, not having the same limitation, would be adopted eventually. Suggestions for tests to locate defects in the line were given, together with illustrations of test racks.

DISCUSSION.

From the discussion which followed this paper it was evident that many members felt that with the long trains now handled, a more reliable signal apparatus should be provided. A member stated that his road required the signal apparatus to be in perfect order before a train left the terminal, and that consequently there had been some train detentions. Others reported having tried 60 lb. pressure on the line instead of 40, with good results.

ENDEAVORING TO RUN 100% OPERATIVE BRAKES IN FREIGHT SERVICE

A comprehensive paper on this subject was presented by George H. Wood and S. C. Wheeler, extracts from which follow:

"The first consideration is the question of what constitutes an operative pneumatic brake. The general opinion prevalent is that it is one in which the piston moves out of the brake cylinder far enough to close the leakage groove, and not more than 10 in. when a full service brake application is made from at least a 70 lb. brake pipe pressure, remaining so until the usual inspection is made and releasing properly in the usual methods resorted to in making ordinary terminal tests. The only

other requirement is that the foundation brake gear be connected throughout to bring the shoes to the wheels.

"The second consideration is the question of what constitutes 100 per cent operative brakes. Our opinion in this respect contemplates that each brake in a train be operative as above stated and so connected that they may all be operated from the locomotive. This will constitute 100 per cent operative and meet all the requirements but one, namely efficiency. The highest efficiency required to meet general conditions being that the train may be controlled by the engineman without the assistance of trainmen with the ordinary hand brake.

"Any one point on a large system attempting to run 100 per cent operative brakes would be immediately confronted with a prohibitive number of cars with inoperative brakes and a congestion that would cause serious delays resulting in this particular point being criticised for tying up traffic. Relief for this particular terminal could only be brought about by allowing inoperative brakes to proceed, or by increasing the amount of the brake work done at terminals on either side. It can readily be seen that any one railroad attempting to run 100 per cent operative brakes would be placed in almost the same position as the one terminal above mentioned, particularly at those points where heavy interchange of equipment takes place, and the same rule would apply between the railroads involved.

"It is found necessary to accept cars at interchange points, although we are unable to discover inoperative brakes because there are no pressure lines on transfer tracks and the defects rendering the brakes inoperative are not visible. These cars are placed in trains before any test can be made to discover such conditions, and would result in delays if cars were bad ordered at that time for repairs. The best we can do under these conditions is to take such cars to the first terminal where provision is made for making necessary repairs.

"It is also found necessary at heavy interchange points, of which there are a number, where cars are handled to our lines in regular transfers by switch engines, to pipe the train yard and provide inspectors to charge up and test such trains and bad order such cars as are found with inoperative brakes. This provides a means of getting a large number repaired and placed in their regular trains for departure; however, there is also a considerable number of cars that it is necessary to hold over 24 hours for connections. Those cars that are picked up at interchange points by the regular freight trains are in most instances held 24 hours on account of being bad ordered and missing connections while passing through repair tracks.

"After facilities and materials are provided, there is the problem of procuring men who are competent and reliable or men who can be educated in a reasonable length of time. We find men who will do work properly while watched and who will slight work if possible. An improperly worked triple or cylinder will not run the required time, and it sometimes requires a long time to discover a dishonest workman. The better the supervision the less trouble there is from this source.

"One of the conditions we find it hard to overcome is the careless manner in which some of the air brake work is done; this frequently causes delay at terminals to get the air brakes in good condition. Cars have been known to come off the transfer track to the receiving road with a bright new stencil representing that the air brake cylinder, triple valve and collector have just been cleaned. The car is sent out on the receiving road with the brake in apparently good condition, but upon reaching the next division point the brake is tested and found inoperative on account of worn packing leather, dirty condition of brake cylinder, or other defects that would indicate that the car had only been stenciled and no work done.

"A large proportion of brakes found 'cut out' in trains on being tested out are found to be in first-class condition and in a great many cases the best brakes in the train. We find trainmen cutting out brakes that do not release as soon as others, not waiting until the brake pipe pressure has been raised high enough to release the brakes having the best packing leathers. We find men who have a hobby of keeping the caboose brake cut out because they are afraid of sliding wheels, and others who will cut out cars and bleed them in order to make a switch quickly at some other point.

"We find enginemen, particularly with small engines, who will cut out tender brakes because the triple does not release promptly or because they are afraid of hangers breaking, and others who will insist on having the piston travel let out beyond the limit on cars, claiming that the brakes drag. Cars are found with the brake 'cut out' and on which nothing is found wrong except the retainer turned up, and others with nothing but a leak at triple valve union, requiring only a turn of a wrench to stop.

"All of these things work against the percentage of operative brakes and are irregularities against which a crusade would have to be waged on every division of every railroad concerned. Some form of defect card must be adopted to be applied by the man cutting a brake out on the road showing who cut it out and for what reason. Such cards are now in use on many roads, but generally speaking there is no check on trains arriving in terminals as to whether brakes were cut out by the incoming crew or not, and consequently the men who take an interest in the equipment are the only ones who apply the defect cards. If a train leaves a terminal with all brakes working (which would obtain if the 100 per cent rule was adopted) and arrives at the next with brakes "cut out" and no card applied, the inspectors would be required to report same so that trainmasters in turn could handle with the crew. And when it is found that some man is cutting out cars when nothing is wrong with them, he can be corrected in his faults. This would have a tendency to cut down the number of such cut out brakes.

"Erratically working feed valves on locomotives are often responsible for brakes being cut out, and generally these are the most sensitive ones in train. The feed valve should be tested out each trip to show that it is sufficiently sensitive to control the brake pipe pressure within a variation of 2 lb.

"What might be called 'dead lines' should be designated at a reasonable distance over the road—terminals where facilities are the best—as 100 per cent points where no inoperative brakes are allowed to pass, regardless of lading.

"At all terminals where there are facilities dead freight loads and empty cars with inoperative brakes should be

caught and repaired. All cars on repair tracks should have their brakes carefully tested, and if the cleaning date is over nine months past on home cars, the brake should be cleaned, which would avoid the necessity of putting the car on the repair track again in a short time, when it might possibly contain an important load.

"If we give more attention to the empty car, putting the brakes in working condition while it is empty, we will have few cases of delays to loaded cars. We have seen cars tested for leaky roof and thoroughly inspected for important shipments, and right at the time of this inspection the brake was inoperative and no attention was given it.

"If we wait until the trains are made up in the yard to make the inspection, we will have delays and bad cars, but if we require the men on all incoming trains to have the train fully charged and then make the required application of brakes before cutting off the air brake inspection can be made at the same time as the usual train inspection, and any cars "bad ordered" can be switched out in the usual switching time. The air brake inspectors must go over the train as soon as the application is made, marking cars that did not apply or that leaked off, also marking cars that have piston travel too long or too short, paying no attention to cleaning dates. The car inspectors in coming over the train must watch the cleaning dates and place bad order tags on any old dates and also on cars marked as having inoperative brakes by the air men.

"We will be confronted with the argument that this does not constitute 100 per cent, as cars are allowed to pass many terminals inoperative, which is a fact; but it is certainly a long stride in the right direction and about as near to 100 per cent as can practically be obtained under the general conditions throughout the country; and, like the one terminal referred to in the beginning of the paper, help must come from other sources. We believe that roads now trying to run 100 per cent find themselves in this predicament and that all will have to set their goal on this line to get the ideal. We believe that if every railroad would adopt the means outlined, flexibly at first, and gradually drawing the lines tighter, that in time we would have a practical working 100 per cent. And that after that point is reached there would be little more trouble in maintaining it at that standard than now obtains with the 85 per cent standard.

"The question arises as to what is to be gained by increasing the number of operative brakes. One advantage is the wider margin of safety in the ability to stop in a shorter distance, in cases of emergency. The advantage more frequently cited, however, is the resultant reduction of slack action in long trains, which contributes largely to troubles arising from break-in-twos.

"We realize that there are many obstacles to be overcome, and we realize that, due to conditions in the United States over which our companies have no control, it is hard to get financial aid for betterments of this kind. But every move we can make along this line is a step in the right direction, and we believe that if a recommendation is made for 100 per cent operative brakes in freight trains out of terminals having repair facilities, it will be well in keeping with the motto of this association."

DISCUSSION.

The discussion on running 100 per cent operative brakes brought out interesting suggestions for improving brake conditions. A number of members advocated the use of a "dead line" as being of great assistance to the general air brake inspector in maintenance. The application of defect cards by conductors was suggested as a means whereby cars could be recognized and given prompt attention at terminals. It was also suggested that brakes be inspected and cleaned while cars were on sidings, where they necessarily had to be idle for a time, thus doing away with any loss of time. One member stated that on his road terminal tests were made by the switching locomotive which made up the train. In connection with the design, a speaker stated that the drawing board was the place to get the pipes right.

MISCELLANEOUS REPORTS AND ADDRESSES

The committee on "Need of Efficient Cleaning and Repairing of Freight Brakes" did not present a report because of the illness of one of the members and lack of time. Mr. Farmer stated that the committee had conducted some extensive tests on the Northern Pacific and had some valuable data, but had been unable to work it up. He urged that the committee be continued and the subject carried over until next year, and his suggestion was adopted. The report on recommended practice was presented by the committee consisting of S. G. Down, G. R. Parker, H. A. Wahlert, J. R. Alexander and N. A. Campbell. The recommendations were adopted with a few changes. The Committee on Constitution and By-Laws presented its report, and the changes recommended were adopted with slight exceptions.

During the sessions E. H. DeGroot, superintendent of transportation of the Chicago & Eastern Illinois, and M. H. Haig, mechanical engineer of the Santa Fe, favored the convention with inspiring talks.

ELECTION OF OFFICERS

The following officers were elected: President, J. T. Slattery, Denver & Rio Grande R. R.; first vice president, T. W. Dow, Erie R. R.; second vice president, C. H. Weaver, New York Central R. R.; third vice president, C. W. Martin, Pennsylvania R. R.; secretary, F. M. Nellis, Westinghouse Air Brake Co., Boston, Mass.; treasurer, Otto Best, Nathan Mfg. Co. George H. Wood, T. F. Lyon, J. F. Berry and Mark Purcell were chosen as members of the Executive Committee. It was decided to hold the 1916 convention at Atlanta, Ga., on May 2, 3, 4 and 5.

MEETING OF SUPPLY MEN

The following were among those supply firms represented: American Steel Foundries, Ashton Valve Co., Crane Co., Joseph Dixon Crucible Co., Detroit Lubricator Co., Garlock Packing Co., Greene Tweed & Co., Johns-Manville Co., New York & New Jersey Lubricant Co., U. S. Metallic Packing Co. An exploitation meeting was held on one afternoon at which various supply men were given an opportunity to speak of the merits of their devices and on another afternoon three lectures were given by representatives of the leading air brake manufacturers.

Economical Practice at Burnside

Co-operative Methods and Savings Effected at the Main Shops of the Illinois Central

The main shops of the Illinois Central system are located at Burnside (91st Street), Chicago. Shop buildings were first located here in 1893 and as a whole they are what would now be classed "old shops." As is often the case with a road which grows steadily in size importance, additions have been made from time to time as necessity required. However, a visit to these shops proves that with good management and team work, they are accomplishing results which will give pointers to many modern plants, provided with every facility and advantage.

The shop management prides itself especially on its reclaim work and during the past nine months this has been highly developed, with the result that it assisted very materially in normal working conditions at the shops. During the month of March 1915, the reclaim work of the shop and store effected a saving of $22,000 and during one record month the saving was $32,000. This is actual, down-right saving, on which the shop management is prepared to show anyone from Missouri. It should be mentioned that the shop operates its own reroll mill.

Garbage Can Made from Old Metal Roofing.

Some of these savings are as follows: A new end of rerolled iron is welded on truss rods, under a Bradley hammer, and they are then used on coal cars at a saving of 39 cents on each rod. Truss rods are also used for the manufacture of car bolts.

The metal roofing from dismantled box cars is made into garbage cans and water pails. Garbage cans are painted white and placed at frequent intervals around the grounds and buildings. Corner posts and center plate guards for passenger cars are made from scrap side sheets. Because of the holes, the angles do not present quite as neat an appearance as the purchased angles, but a saving of $3.20 a car, or 80 cents an angle is effected. Radial staybolt and "limed" iron is passed through the rattler removing the crystallization from the scrap iron and is then made into engine bolts, which have proven entirely satisfactory. Transom plates of arch-bar trucks are made into striking plates for box cars. Carrier irons are made from old arch bars also.

"Shingled" iron, as it is called, consisting of bolt iron, arch bars, spring rigging, scrap stay bolt iron, etc., is worked up into bars and provides a good grade for tail-strap and draw-bar pins. It is worked nine times and each bar is stamped with a "B" enclosed in a circle, so that the reworked iron can always be distinguished. This material is prepared for reworking by being made up into little boxes about 1½ ft. by 10 in. by 8 in. high, the sides being composed of old arch bars.

Some sill steps are made from truss rods. Nuts are removed from bolts and rods in a special machine. Old flues are taken three at a time and flattened out and are then used to bolt car sills over the sheathing, effecting a saving of 35 cents over the use of new iron for this purpose.

Reinforcing Fox Trucks.

Brake beams are stripped of bolts and other accessories and make very good side stakes for coal cars. Fox trucks are patched and reinforced very thoroughly by fitting a U-shaped piece of pressed metal, made from scrap steel, inside the frame and bolting it. For doing this a portable double acting air cylinder is placed between two truck side frames and after attaching loops to hold the two frames, one of these U-shaped pieces is pressed into each frame by the air cylinders. The holes for bolts are drilled while it is in position.

There are four portable alligator shears in use for cutting up old iron, each mounted on a flat car with a suitable housing over it and driven by a gasoline engine. Several small buildings about the scrap yard are made of old metal car roofing. Swing doors on sand and construction cars are made from box car siding. They

Flattened Flues to Reinforce Car Ends.

Stripping Babbit from Worn Bearings.

are made in three layers, which prevents them from warping. Superheater units are butt-welded by the Thermit process, with excellent success. The welds are smooth and finished in appearance and as strong as the pipe itself.

Box car ends are being reinforced by iron bands made of 3 in. scrap flues which have been flattened. These are placed over a wooden backing sill, having a thickness of three inches at the center and tapering to nearly a point at each corner post. Three of these are used with a two-rail car and two with a one-rail car. An additional feature is a bracing of flattened 3 in. scrap flue iron, running diagonally on the side of the car from the lower end brace to the side sill.

As an instance of the saving now being made in reclaim work it may be noted that whereas a car load of worthless scrap was formerly shipped out every ten days, it now takes three weeks for a carload to accumulate. The car department is a busy place and the planing mill is running from 60,000 to 70,000 feet of lumber per eight hour day.

An addition to the power house has been built and is being prepared for the reception of two Nordberg compressors, having a capacity of 2,000 cu. ft. each. It is easy to see that the chief engineer of the power plant at Burnside looks after his machines and takes great pride in them. There are few shops that have as well kept and up to date a power house. Near the boiler house is a large tank placed in a sump. Returns from all the heating systems of the plant are brought back into this tank, and the water there is heated by the exhaust of the near-by pump which pumps the water at a temperature of 200 to 220 deg. back into the feed water line. One of the points on which the management is very particular is that of steam leaks—these have been cut to practically nothing. The same is true of air leaks—a man makes the rounds every night for the purpose of detecting them. One of the interesting processes about the shop is that of relining bearings; this is done in one corner of the tin shop. The bearings are fed into a combination machine and furnace, which melts the babbitt off. This machine has an endless chain about 1½ ft.

Inside View of Machine for Tinning Bearings.

Revolving Table for Babbitting Tinned Bearings.

Garden in Front of Freight Shop.

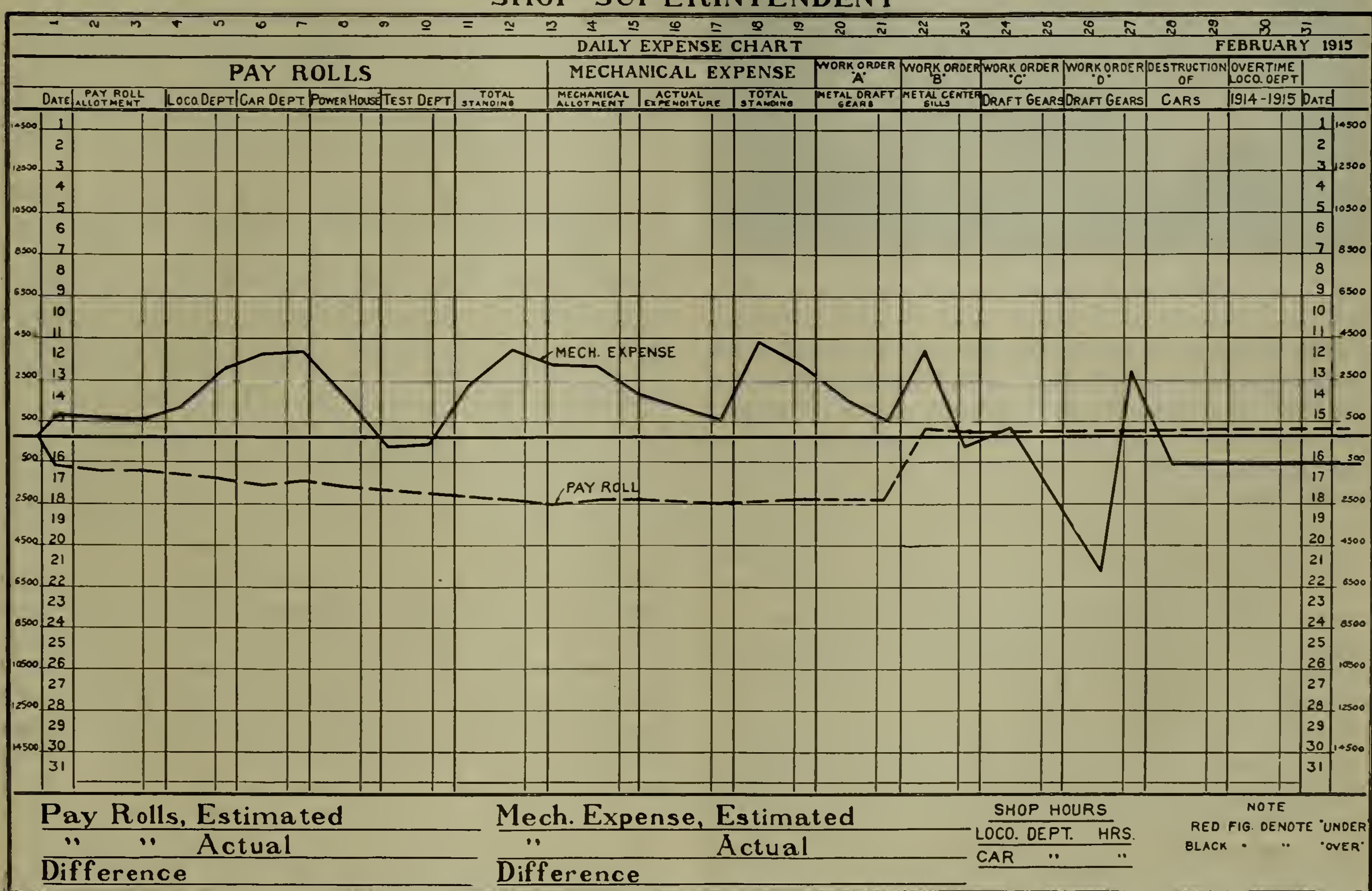
wide, which runs on an angle of 30 deg. down into and through a bath of molten babbitt. The bearings are fed into the endless chain and pass under a wheel shaped arrangement when partially through the molten metal, which releases the babbitt. The metal is kept hot by means of the usual furnace and the babbitt is drawn off from time to time. A hood covers the entire top of the machine, and all vapors are removed. With this machine about 225 bearings are melted per hour. Alongside this machine is a second, similar one, into which the bearings are fed for tinning. Upon coming out of this machine, they are placed on a metal table, 6 ft. in diameter, which revolves bringing each bearings into close proximity to the man at the forge. Preceding operations are taken care of by a man working at another point on the table circle. The bearings are placed in a double jig or holder, and are drilled out two at a time. The machines referred to were designed by A. Paulus, foreman of the tin and pipe shop.

The work of the tool department was described in the March, 1914, issue of the *Railway Master Mechanic.* Since that time, it has increased its scope and is now the central manufacturing tool room for the system. An order for tools from Memphis, for instance, would be sent here through the store department. The tool room fills the order, charging Memphis for the tools. A set of books is carefully kept, monthly inventory taken, and the books balanced. A complete record of all rough-material, partially completed, and completed stock on hand, is also kept. A feature of the tool room is a neat sterilizer for goggles, containing a drawer for the goggles together with a jar of wood alcohol and a jar of water.

One of the busy departments is the spring department, which is turning out on an average of 8,000 lb. per day, and during March turned out 211,000 pounds.

In the office of the shop superintendent is a daily expense chart, which is placed in a glass case on the wall back of his desk. The information which this contains enables him to see at a glance how his pay roll and expenses stand from day to day. A new chart is made up for each month, and the old one is filed for reference. In addition to showing general expense items (posted daily), the chart has a pay roll curve, and a combined

SHOP SUPERINTENDENT



Daily Expense Chart.

curve of the shop and master mechanic's expenses. A glance will show which way expenses are going, a fixed datum line indicating the appropriations within which the department is supposed to work. Under glass covers on the wall are blue prints showing the location of tools in the machine ship. On the glass over the location of each machine is pasted a small bit of white paper, upon many of which is the notation "O. K.," and one might judge that some tools were all right, while others were not. This is not the case; the shop management is gradually effecting a re-arrangement of all the tools, with a view of increasing the output and the machines marked "O. K." are correctly located. The basic idea is to group the driving box work, for instance, so that the gang foreman can see and superintend his work from a central position. As a re-arrangement is made without disturbing the shop routine, the work is necessarily slow. It is expected that it will take some time to complete this work.

The spirit and principle prevailing in the shop, and emanating from the general superintendent of motive

Sterilizer for Goggles in Tool Room.

power down, is to put every man on his merits. The foremen are given their work, and the policy is that of non-interference, unless absolutely necessary. It is up to every one to get results. The result has been to develop more capable officials—men who at a minute's notice are ready to step into the next higher job. The shop superintendent has two general foremen, one for cars, the other for locomotives, who report directly to him, and who have full charge in their respective departments. Three others report to the superintendent direct, because their work covers all departments. These are the emergency gang foreman, the chief engineer, and the foreman steam fitter.

A shop craft committee was organized early in 1912, since which time there has been increased satisfaction among the employees. This committee is composed of a representative from each group of craftsmen in the shop—one from the machinists, one from the painters, one from the blacksmiths, etc. Originally the foremen appointed a representative member from each group, and thereafter the organization was continued by each man appointing his successor, the term of office being two months. A meeting of this committee is held once a month in the shop superintendent's office and each member is called upon to air his views. If any particular group feels that certain conditions should be changed, it has ample opportunity to make its views known, with the assurance that they will be carefully considered. Those matters which can be so taken care of are disposed of by the shop superintendent, while others may be passed on to the superintendent of motive power. The men understand, however, that individual grievances must be taken up with the foreman. The rotation of members allows six different men from each group each year to serve on the committee and to work with the management to the best interests of all. These men also serve as members of the shop safety committee and once a month they get together and inspect the whole shop plant thoroughly.

EDUCATING EMPLOYES ON THE FRISCO

It is proposed by the officials to make every town along the line a recruiting station for the Frisco. Nothing could be more desirable than that everyone in the Frisco service should have been reared in its territory, and with this object in view every possible effort consistent with fair play to those who are or have been in service will be made to give positions to applicants who live along the line.

At the same time the officials realize that the Frisco has neither the time nor the money to act as a training school for raw recruits, neither has it opportunity to discover the natural bent of applicants for positions. But to further its plan it is proposed to have the superintendents and those under them deliver short talks upon the different branches of railroad service at the schools, at points on their divisions, or whenever opportunity offers. These talks will be upon all branches of railroad service and will be given as often as desired.

It is believed that, with this information, the schoolboy will have an opportunity not only to learn something about railroad service, but to discover his natural bent. It may be that his railroad knowledge is confined to mechanics or operation, whereas, if he had a glimpse of traffic, he would discover that it appealed to him as of greater interest and he could be guided accordingly. The Frisco Man, the magazine of the Frisco, will at an early date begin the publication of a short catechism on everything in the railroad service from locomotives to tariffs. These will be placed at the disposal of the superintendents, who will give them to the boys who may be interested.

It is believed by doing this that the number of raw recruits will be greatly reduced, the work of selection will be lessened, and the time lost in fitting round pegs in square holes will be diminished; that the Frisco will gain the services of new employes who will have some knowledge of railroad service, and will also be a further gainer in the fact that those who are employed live in and are acquainted with its territory.

Glen Rose & Walnut Springs has given a contract to the Rail Road Construction Co., New York, for work on a section of the line.

Master Boiler Makers' Convention

Among Interesting Reports Submitted Are Those Giving Results of Oxy-Acetylene and Electrical Welding

The ninth annual convention of the Master Boiler Makers' Association was held at Chicago, May 25-28, 1915, at Hotel Sherman. A number of opening addresses were made; Mr. E. W. Pratt, assistant superintendent motive power and machinery, of the Chicago & Northwestern, made some remarks on the relationship existing between the railroads and the Interstate Commerce Commission, and especially regarding the application of the federal boiler inspection law, it being the opinion that a workable basis has been established. He also called attention to railway legislation which had gone to such an extreme that a great deal of it has enacted to the positive injury of the roads and should be repealed. He also advocated the intelligent use of up-to-date boiler shop practice and urged a high standard of maintenance of boiler accessories. He also urged the members to adopt broad and liberal policies in handling subordinates, in order to gain their complete confidence.

The president, James T. Johnson, assistant general boiler inspector of the Atchison, Topeka & Santa Fe Ry., delivered an address covering in a general way the early history of the association and also making recommendations about modifying the constitution and by-laws as affecting the duties of the treasurer and requirements for membership. The executive committee submitted a report recommending that copies of the proceedings be forwarded to the motive power officials of the various roads and commercial organizations represented in the membership. They recommended that the association formally approve the recently revised boiler code of the American Society of Mechanical Engineers. The recommendations were adopted by the convention.

OXY-ACETYLENE PROCESS IN BOILER MAINTENANCE AND REPAIRS

The report on the use of the oxy-acetylene process in Boiler Maintenance and Repairs was submitted by a committee of which T. F. Powers, Chicago & Northwestern Ry., was chairman. The report went into the subject of oxy-acetylene gas and the apparatus employed in its generation and use quite minutely, and reviewed at some length the many operations that are being satisfactorily performed by it in railway boiler shops.

The discussion brought out a number of new uses and processes to which oxy-acetylene is applicable. On the St. Louis & San Francisco Ry. it is the practice to use the oxy-acetylene flame almost entirely either for dismembering or for reapplying fireboxes when locomotives are brought in for their renewal. The removal of back tube sheets was also mentioned, the torch being used to cut them out, leaving the ring that was originally flanged on the sheet riveted to the shell of the boiler. The new sheet properly laid out is welded to this ring, thus the renewal is made without removing a single rivet.

The question of the proper application of new side sheets provoked some discussion, it being contended by many members that the edges to be joined should be allowed a divergence of 1/8 inch per lineal foot of seam to provide the sheet flexibility which will allow it to come into proper position and at the end of the welding operation.

Many other members contended that sheets should be brought into regular alignment with possibly 1/16 or 1/8 inch clearance between; it was contended that after all mud-ring rivets and staybolts have been put in place that it can be satisfactorily welded in that position.

A model of a Wooten type of firebox as employed on the Lehigh Valley R. R. was shown in which the riveting had been reduced to a minimum. A somewhat wider flange than usual is provided in the flue sheet of this firebox so that the weld connecting the flue side and the crown sheets is brought between the first and second rows of the radial stays. This gives an entirely smooth surface on both sides of the sheet and eliminates the possibility of accumulation of scale, which is likely to occur on ordinary rivet heads on the water side and cause overheating and burning off of the rivets on the fire side. It also makes possible a larger radius of flange.

Many members reported no difficulty in welding where the work was interrupted to such an extent that the welds become cold before the operation can be completed. The success in manipulating the work apparently comes from keeping the heat closely localized on the work instead of allowing it to spread, which will introduce difficulties from subsequent contraction of the parts. The rate of welding was given as from 18 to 28 in. of weld per minute by those who had marked success in the work and the cost of the process, including materials and the service of an operator, was said to vary from $1.50 to $2.00 per hour.

The discussion on the subject of electric welding showed that this process was used very extensively for welding in tubes and superheater flues, although its use is by no means confined to this work. The opinion was expressed that for best results it is necessary to retain the copper ferrules with which the tubes are secured in order to prevent leakage, but this necessity was questioned by many. Cases were cited where electrically-welded flues have run the full three years permitted by the regulations of the Interstate Commerce Commission. The opinion was also expressed that it was advisable to weld the flues in when newly set and not to attempt the welding after they have expanded to any great extent.

RIGID OR FLEXIBLE STAYS

Geo. L. Fowler, mechanical engineer of New York city, described some tests which were recently carried out on the New York Central R. R. to determine the action on firebox sheets, flues and staybolts under conditions of heat and pressure. Two boilers were used, the fireboxes being similar except that one was completely stayed with rigid bolts, while the other was completely equipped with flexible bolts. Steam was gotten up in the usual manner employed, the maximum pressure was held 15 minutes, and the boiler was blown down at a rate of

approximately one pound per minute, requiring three hours to run the pressure down to zero. In the second test the pressure on the boiler was blown through the throttle valve, the main valves of the engine being removed to permit this action. The test showed that the staybolts in the boiler are constantly under motion and rarely if ever subjected to a direct tensional strain. This indicates the great desirability of using flexible stays as did also the movements in the boiler which had flexible stays; these roughly were twice those of the one which was rigidly stayed.

Every opening of the door in the ordinary process of firing was observed to cause a decrease of 250 to 300 deg. in the temperature on the fire side of the sheets, while at the same time there was a corresponding movement of the sheet and the bolts supporting it, indicating that vibrations and stresses are prominent factors in shortening the life of those parts.

Other reports were given Wednesday afternoon on the relative merits of basic and acid steel as material for firebox construction, and also on the subject of providing for uniform stresses in staybolts and boiler braces. No action was taken on the first subject and the consensus of opinion was that the second matter is fully covered by the regulations of the Interstate Commerce Commission and needed no action by the Association.

FEED WATER FOR LOCOMOTIVES

Under the subject of feed water for locomotives it was shown that by the introduction of wayside water treating stations it has been possible to increase the mileage in a set of flues from 100 to 300 per cent. A serious question arose, however, as to the increased pitting of boiler flues and sheets as a result of the application of feed-water treatment, particularly those methods which use soda ash. Many members reported that pitting was greatly increased, and as an explanation of this fact it was stated that the waters likely to cause this action contain some corrosive element which was formerly prevented from coming in contact with the metallic surface by the accumulation of scale.

A representative of the Western lines of the Canadian Pacific Ry. reported that the polarized-mercury treatment had given more satisfactory results than any other and had produced an increase of 33 to 50 per cent in the mileage of any given set of flues.

A brief treatise on the matter of circulation in a locomotive boiler was given by a representative of the boiler inspection force of the Interstate Commerce Commission. A model was exhibited which showed that the circulation of water is from the forward end of the boiler down past the flues to the lower portion of the firebox, then up and past the sheets comprising that member, and thence back toward the front end of the boiler. It also showed marked agitation and apparent increase of the circulation about the firebox sheets whenever the injector was applied or the safety valve or blower was in operation.

The circulation over the crown sheets was also shown to be very much augmented by virtue of the arch tubes.

L. W. Wallace, assistant professor of railway and industrial management at Purdue University, described a series of elaborate experiments on the Chicago, Indianapolis & Louisville Ry. to determine the zone of danger from fires caused by locomotive sparks, and reported that fully 90 per cent of danger from this source is within a distance of 100 feet on either side of the track.

MISCELLANEOUS PAPERS AND REPORTS

Tuesday afternoon the subjects of strength of the shells of locomotive boilers as affected by pitting and corrosion was taken up, and also the subject of approved methods of driving and setting staybolts and radial stays.

The committee in general expressed the opinion that pneumatic tools should be used in the latter operations. The use of the long stroke hammer for cutting off bolts after they have been inserted was condemned, as the hammer has a tendency to elongate the holes, making it difficult to get the bolts steam tight in the sheets. To obviate this trouble one road is cutting off the bolts with the acetylene torch and, while it costs more, the superior work is considered worth it.

The cutting off of bolts squarely or having them slightly beveled was taken up in the discussion and the former practice was advocated because a slight elevation at the center of the bolt facilitates the upsetting or the expansion of the bolt in the hole, and makes a much tighter connection possible. It was not conceded definitely by the convention that the form of the end of the bolt had a great deal to do with it, but it was conceded to be highly important that the bolts be made to completely fill up the hole.

Tank construction was taken up in the Thursday meeting and the flanged-bottom tanks lately developed on the Lehigh Valley R. R. were cited as the last improvements in the boilermaker's art. The bottom sheets are flanged to dispense with connecting angles in the corner seams and to bring all the rivets into a horizontal plane. When thus arranged no leaks can occur (except through the plates themselves) that will require the removal of the tanks from the frames to caulk them. A similar design uses several sheets in forming the bottom of the tank, all of them having edges flanged upwardly to receive the connecting rivets.

In the Friday morning session, approved methods of renewing fireboxes were taken up. It developed that the oxy-acetylene torch is being used to cut away the fireboxes from the shell in the vicinity of the throat seam. Boilers are also removed from the frames by disconnecting at the smoke arch rather than at the saddle. The method of taking out the back head to permit the introduction of a firebox is regarded as being too expensive a process to be followed in regular practice.

The process which it is advantageous to use was stated to depend largely on the amount of space available in the boiler and erecting shops respectively, and the means at hand to facilitate the handling of the boiler in the maintenance department.

ELECTION OF OFFICERS

The election of officers resulted as follows: For president, Andrew Green, Big Four R. R., Indianapolis, Ind.; first vice-president, D. A. Lucas, C. B. & Q. R. R., Havelock, Neb.; second vice-president, John B. Tate, Pennsylvania R. R., Altoona, Pa.; third vice-president, Chas. P. Patrick, Erie R. R., Cleveland, O.; fourth vice-president, Thomas Lewis, Sayre, Pa. The secretary of the association is Harry D. Vought, 95 Liberty Street, New York.

OVER THE TIN CUP

It was noon time, and the hour was announced first by a distant town hall clock and a second later by a battery of deep toned factory whistles which roared out their message in wild brazen notes. The familiar noon time silence was spreading everywhere. The rattle of air hammers in the steel car shop suddenly ceased, and the droning melody of the big rip saw and planer in the wood mill died away.

"How Long Will Those G-28 Gondolas Stay Off the Rip Track, Bill?"

The sudden hush was broken by a muffled sound of many feet and the clinking of dinner pails as the carshop and rip-track crews sauntered over toward an open repair shed to eat dinner in the shade.

"How long will those 'G-28' gondolas stay off the rip track, Bill?" asked a car whack of Big Bill's rip-track crew.

"Just long enough to give us time to requisition a new bunch of striking plates and couplers for them," said Bill. "We can keep right on fixing them as fast as they come in, but take it from me, kid, two class 'G' springs ain't the right kind of medicine for a sick car. It needs the best kind of a draft gear specialist to cure it."

"Aw, hire a hall for that tragedy stuff." Thus spoke a brawny car toad who was in the roofing gang. "Don't you fellows ever stop to think that the rest of us have trouble too? Just look at me and Tom when we're trying to spot a roof leak on one of those A-20 box cars, when the water has gone through a rusty hole in the tin near the end plate, and then worked back and leaked inside near the side door. We invent cuss words that are hot enough to set fire to a wet floor plank. What we need is a metal roof that is made out of a real piece of metal, not tin can material."

"Some oratory for a car toad," remarked one of the broad shouldered members of the truck repair crew, as he imbibed a huge draft of coffee. "Manicuring a roof ain't the hardest job on earth; when you and Tom want a little real work, come over and give us a lift overhauling a few of those C-3 trucks in the refrigerator service. Try some of those new cuss words of yours on oil box bolts that are rusted tight from dripping brine. Try to balance on your left ear, while you use both hands and feet, to get a cotter pin in place on the bottom rod end of a dead lever. You'll beat it back in a hurry to where the rest of the running board squirrels are plugging up pin holes in roofs."

"What kind of roofs did those F-2 flat cars have?" asked a small weather-beaten car toad who instantly dodged a shower of bread crusts, egg shells and other eatables, and proceeded to fill up a villainous looking corn cob pipe with a charge of Tip Top.

"Those roofs were made by the same firm that supplied us with stained glass gondola windows, Shorty," said Big Bill, as he partook of a generous chew of Peerless. He drew himself up to his full height and lazily stretched out his massive arms as he looked over toward the rip tracks. The yard engine was shoving in a G-28 gondola; the wheel flanges squealed and groaned over the battered switches and rough curves; it was back again for draft gear repairs.

"There's one of our old friends back again," said Bill, as he sent a fiery stream of tobacco juice at a large blue bottle fly that was sunning itself upon an old coupler. "I handed out the right kind of dope when I said those cars would stay out just long enough for us to get in repair parts for them. The old proverb of a stitch in time is all O. K., but we can't benefit by it because we haven't been putting in the right kind of stitches."

"That proverb worked out all O. K. for us, Bill," said an elongated machinist who was strolling back toward the machine shop. "Another Nut Splitter with a big idea," grunted Big Bill as he looked upon the newcomer with a critical eye. "What's the dope, Slim? let us in on the ground floor." "There ain't no secret to it, you overgrown wood butcher," said Slim. "It's only a simple matter, but, be that as it may, we'll raise the Old Man up on top of the gold plated pedestal of supreme forethought for the good turn he did for us machinists."

"Aw, Hire a Hall for That Tragedy Stuff"

"Here's the dope; for the last fifty years we never had a decent bench to put a vise on. They were all on the bum; some had cracks between the boards big enough to drop an 'S' wrench through. They all were rickety and chewed up worse than a chopping block, and never stood up under heavy work. Well, one fine morning a bunch of castings were dropped off for us, and we couldn't dope out what kind of a machine they were for. They were legs of some kind and were almost as strong as those under the speed lathe bed."

"Later on the old man blew in with a Carpenter, and that same day we had the finest set of benches in existence; solid as a rock in all directions and as neat as a pin."

The Superintendent's Stenographer tripped lightly along the board walk, shaded by a small silk parasol, as Slim shook the crumbs out of his lunch box. "Yes, sir," said he. "There is some class to them all right." Immediately there was a shuffling and squirming among the car toads; Big Bill made a desperate effort to adjust his greasy neck tie, one of the roofing gang quickly inspected himself in a pocket mirror, and everyone tried to spruce up a little. As the trim young lady glided past the repair shed, the brawny gang stood at attention in silence.

"Some Oratory for a Car Toad"

"Some Doll all right," whispered Big Bill as she disappeared from sight.

"Now wouldn't that rattle your crank pin?" growled Slim. After me delivering a four hundred dollar Chautauqua lecture to you strong arms, that all bear the scars of matrimony, it slips off your cast iron skulls and you all get temporary heart failure when a good looking skirt comes down the line."

The whistles sounded and the blower in the blacksmith shop sent forth its muffled roar. From the steel shop came the rattle and ring of the air hammers, and the big rip saw and planer joined in the medley with their ceaseless monotone. A locomotive crane puffed and grunted as it lifted a bunch of scrap iron with its magnet, and the noon hour was forgotten.

The Erie R. R. is reported to have settled all disputes with cities that have been holding up its construction plans, and it is probable that work will be started on the final 49 miles of double tracking between New York and Chicago. This is divided into three sections: 35 miles from Griffith to Lamox, Ind.; 9 miles from Waterloo to Sternberg, N. Y., and 5 miles between Allegheny and Carrollton, N. Y.

The Ocmulgee Valley, a proposed 20-mile line from Lumber City, Ga., to Jacksonville, has completed 10 miles of road and has other sections under construction. The work is being done by day labor.

INTERNATIONAL GENERAL FOREMEN'S ASSOCIATION

The annual convention of the International Railway General Foremen's Association will be held at the Sherman Hotel, Chicago, Ill., July 13 to 16, inclusive, 1915. Advance copies of the topics to be discussed will be in the hands of the members 30 days prior to the convention, so that all may familiarize themselves with their contents and go to the convention fully prepared to air their views.

The experiment tried out last year of dispensing with the reading of the papers at the time of the convention proved such an unqualified success that the same procedure will be followed this year. The committees have done very faithful work, and able papers have been prepared.

The topics to be discussed embrace the following: (1) Valves and Valve Gearing, Mr. W. Smith, Chairman; (2) Rods, Tires, Wheels, Axles and Crank Pins, Mr. Masters, Chairman; (3) Shop Efficiency, Mr. Logan, Chairman; subsidiary papers, (1) Roundhouse Efficiency, in charge of Mr. Whitse; (2) Oxy-Acetyline Welding, presented by Mr. Byers. The Supply Men's Association are surpassing themselves in the preparations they are making to insure the success of the 1915 convention.

DEVICE FOR TRUING WHEELS

Patent No. 1136124, issued April 20, 1915, to the Wheel Truing Brake Shoe Co., Detroit, Mich., describes an apparatus for truing wheels without removing them or jacking up the cars. This device operates equally well on idle wheel (trailers) and on geared wheels (drivers).

A section is cut out of both rails of a track, opposite, for a distance of some two feet. This section of rail allows one pair of wheels to drop down and rest on two driving wheels each, which drive by means of friction and are actuated by an electric motor through suitable gearing. Levers are provided for holding wheel-truing brake shoes against the surfaces of the wheels and also for providing the proper tension to secure even grinding. The wheels on which the truing shoes are working can be run independent of any other power. The section of rail is cut on a bevel in such a way that it can be replaced and held in position by dowel pins. The Wheel Truing Brake Shoe Co. does not plan to manufacture this apparatus, but allows such of its patrons as wish to grind wheels in their shops, rather than on the road, to make up a cheap and practical wheel grinder to be used in connection with the well known Wheel Truing Brake Shoe. The material necessary for the construction of this grinder is to be found in or about almost every car shop, and the entire grinder can be easily assembled.

Surveys are under way for railroad for Newton Falls Paper Co., Newton Falls, N. Y., to tap new timber tract. James P. Brownell, Carthage, N. Y., is engineer.

J. E. Morrison, Bellingham, Wash., has appeared befor the Chamber of Commerce of that city, petitioning that $250,000 be pledged to cover right-of-way expense for the proposed transcontinental line from Hudson Bay to Puget Sound.

Convention of Railway Storekeepers

Subject of Scrap Covered in a Comprehensive Manner---Other Instructive Reports Submitted

The 12th annual convention of the Railway Storekeepers' Association opened at Hotel Sherman, Chicago, Monday morning, May 17, with President G. G. Allen, general storekeeper, Chicago, Milwaukee & St. Paul Ry., in the chair. William Hale Thompson, recently elected mayor of Chicago, was present in person and extended the city's welcome. His remarks were responded to by J. H. Waterman, past president, superintendent timber preservation of the Chicago, Burlington & Quincy R. R., who incidentally defined the up-to-date storekeeper, for the mayor's benefit, as an official who always has on hand everything that is wanted, and never has on hand anything that is not wanted, and handles his material without cost.

E. D. Sewall, vice president Chicago, Milwaukee & St. Paul Ry., was present by invitation and delivered an address upon "The Railways and the Public."

At this point in the programme president Allen presented the usual president's address in which he reported a very profitable year for the association.

The reports of the secretary-treasurer, the auditing committee and the membership committee, concluded the morning session, all showing a satisfactory state of the association's affairs.

SCRAP AND SCRAP IRON CLASSIFICATION

The report of the committee on scrap and scrap iron classification, W. Davidson, chairman, Illinois Central R. R., Chicago, was presented Monday afternoon from in which he said in part:

"The real meaning of the word scrap is not fully understood by the average railroad employe. To most people scrap implies something useless, without value, and to be disposed of only by being cast away. The fact that an article has been cast off does not imply in any way that it is without value for some other purpose. The economical handling of scrap in all of its phases is one of the most important branches in connection with railroad operation.

"The cost of handling scrap should be considered carefully, as duplicate handling is very expensive. There are some kinds of scrap having such small market value that if handled through one or two operations at the scrap yard or on the line of road, the actual cost of handling is greater than the amount realized from sale. On the other hand, with certain kinds of scrap one handling or operation such as sorting out pieces of certain size or length, or cutting a few bolts and rivets, will result in a saving of several dollars per ton when the scrap is placed on the market."

The report went on to tell in detail methods of collecting and loading scrap and of delivering it to the most convenient destinations. The selection of equipment and also the problem of back haul were considered. Suggestions as to economical switching and the elimination of foreign cars in scrap service were made.

The report concluded with a schedule of items of scrap that the association's classification does not cover, which was offered with the suggestion that it would make it possible to so prepare the scrap as to get a better price in selling it.

Some discussion was contributed on this subject, most of which centered around the propriety of a classification of miscellaneous mixed scrap. Some members maintained that a classification of that kind is necessary and others claimed that a miscellaneous classification invalidates or at least weakens the whole schedule and for that reason should not be established. At this point the chair considered it apropos to inquire what roads represented at that meeting are now using the association's standard scrap classification.

It was finally moved and carried that the committee's recommendations be adopted, with the exception of the recommended changes in the classification, which latter were taken up item by item. Nearly all of the changes suggested had the approval of the meeting. The classification of miscellaneous mixed scrap was finally discarded by the meeting and the present classification in that respect allowed to stand.

RECOMMENDED PRACTICES

The report of the committee on recommended practices was read by the chairman, D. D. Cain, general storekeeper of the Seaboard Air Line, Portsmouth, Va. The committee, instead of recommending any new practices in its report, took occasion to reiterate some of those which the association had previously approved.

RECLAMATION

The report of the committee on reclamation, chairman D. C. Curtis, inspector of stores, Chicago, Burlington & Quincy R. R., Chicago, was presented Tuesday morning. This report treats so comprehensively on the subject of reclamation that further opportunity will be taken to reproduce it and comment upon it.

In connection with its work the committee had collected a quantity of photographs and data showing the reclamation plants of various railroads, and their operation. A number of these photographs were shown in lantern slides, accompanied by comment and explanation.

F. D. Reed, purchasing agent, Chicago, Rock Island & Pacific Ry., and N. M. Rice, chief purchasing officer, St. Louis & San Francisco R. R., St. Louis, Mo., commented upon this report and agreed with the stand of the committee.

BUTTING IN

By special invitation of President Allen, Mr. J. H. Waterman had prepared a paper entitled "Butting In." The significance of the title appeared with his opening remarks, which referred to the ancient Hebrew institution of the scapegoat, which once a year was sent into the wilderness, bearing, so it was believed, the sins of all the people on its back. Thirty years ago, said Mr. Waterman, the stores department was the scapegoat,

bearing the criticisms of the mechanical, the engineering and the operating department on its back. But now, the figure of speech was continued, the scapegoat has "come back" from the wilderness and is "butting in" to the extent of substituting material on requisition by the various departments. Mr. Waterman declared that any storekeeper of the present day who does not save money for his company by filling the requisitions with the material that will give the proper service at the least money, is "no good." The management, he said, is looking to the stores department for that very duty. He concluded with some counsel on using diplomacy so as to avoid jealousy or ill feeling on the part of other departments. Let them claim the credit, Mr. Waterman said, of any given economies; for, after all, the duty of the stores department is to serve the company, and nothing will be gained in the long run by a petty spirit.

ACCOUNTING FOR SECOND HAND SERVICEABLE MATERIAL

C. H. Sampson, assistant auditor, Chicago, Burlington & Quincy R. R., presented the paper. In outlining his subject the author said: "Material returned to store stock is naturally divisible into three classes, for which fixed bases of value can be established as follows: (1) Usable in its present form, value same as corresponding new material; (2) needing repairs to make it usable, value a fixed percentage of corresponding new material when released and full value when repaired; (3) scrap, not fit for use or repairable; value, fixed prices according to kind."

MARKING OF COUPLERS AND PARTS

The secretary read the report of the committee on marking of couplers and parts, A. J. Kroha, chairman, Chicago, Milwaukee & St. Paul Ry., Tacoma, Wash. A committee on this subject has been in existence for a number of years, but the present report is the first definite set of recommendations to be submitted. The report included the following introduction:

"Your committee on marking of couplers and parts has communicated with all the leading coupler manufacturers of the country and, while their suggestions were of some value in work, we came to the conclusion after tabulating various makes and styles of couplers and repair parts which are manufactured at the present time, that it would be better to number all parts, rather than to number a coupler and use a prefixed letter or letters to designate parts of same. We therefore recommend: (1) The assigning of a series of numbers to each make of coupler and parts; (2) a standing committee to take care of assigning additional numbers as required; (3) publication of booklet listing the various parts with assigned number; (4) insistence on parts of purchasing agents to have manufacturers show, in raised figures wherever possible, the number applying to any particular part on body of such part.

STANDARDIZATION OF TINWARE

The report of the committee on standardization of tinware, W. F. Jones, chairman, general storekeeper of the New York Central, West Albany, N. Y., stated that the report originally prepared in 1911 had been referred at that time to the American Railway Master Mechanics' Association, which latter has not up to this time acted upon the matter. There is every prospect, however, that it will be favorably acted upon at the mechanical convention at Atlantic City.

HANDLING OF SIGNAL MATERIAL

A paper on "Handling of Signal Material" was read by another member, in the absence of the author, R. D. Long, assistant general storekeeper of the Chicago, Burlington & Quincy R. R., Chicago. The paper took the ground that signal material should be handled in much the same manner as other material. However, there is special necessity for prompt disposal of second-hand material, on account of the larger amount of money involved, and because the patterns quickly become obsolete. There is also a special necessity for prompt supply of repair material, as the signal system must be kept in working order at all hazards. To this end, the author recommended supply stations for signal material at various places along the line, from which supplies could be obtained on very short notice; also that there be a special storekeeper for signal supplies, for the reason that a practical man can fill his orders in a better manner, and that signal material is of such a nature that it can be better handled by a specialized force, rather than the regular force of the stores' department.

Another paper on the subject of "Handling of Signal Material" was presented by C. R. Ahrens, storekeeper, Delaware, Lackawanna & Western R. R., Hoboken, N. J.

Tuesday afternoon the convention received the reports of the committee on piece work, W. W. Eldridge, chairman, piece work inspector, Chicago, Burlington & Quincy R. R.; on accounting, P. J. Shaughnessy, chairman, storekeeper of the Erie R. R., Meadville, Pa.; on stationery, E. J. McVeigh, chairman, general storekeeper of the Grand Trunk Ry., Montreal, Que., and on uniform grading and inspection of lumber, J. H. Waterman, chairman. From the last we quote:

"There are many occasions when 1 in. by 12 in. by 16 ft. white pine of good grade is ordered when 1 in. by 8 in. by 12 ft. to 16 ft. yellow pine, cypress, spruce or even hemlock of a lower grade would answer equally well for the purpose, and would cost considerably less money. White pine for pattern work is frequently ordered to be 12 inches and over in width, when, if ordered 8 inches and over with a limit on the percentage of widths under 12 inches acceptable, the lumber would cost less, and the widths under 12 inches will usually be found, piece for piece, to be of better quality than the wide stock."

Yellow pine, or oak in one case, would have made a much more durable tool box than clear yellow poplar and at a cost of approximately 50% less. There is no reason for paying for 16 ft. white pine to be ripped to 2 and 3 in. strips for staying explosives in powder cars. Old car siding and other waste material give equal results. Some of the railroads have already gone quite extensively into the substitution of cheaper and more plentiful lumber for high priced, scarce material. Mr. A. E. Manchester, superintendent of motive power, Chicago, Milwaukee & St. Paul Ry., contributed to the discussion.

Some remarks were introduced at this point relative to the practice of refusing lumber that fails to pass in-

spection. It was held that rejected lumber should not be received at any price. One speaker described his practice of confiscating defective material if the shipper did not remove it at his own expense within 30 days. When objection was taken to this method, the speaker stated that his practice of confiscation was made a part of the contract upon which the lumber was bought and that the legal department of his road held that it was perfectly practicable. The discussion ended without positive decision upon the points involved.

The committee on nominations presented its report, which was promptly acted upon by the unanimous election of the following officers to serve for the ensuing year:

President, J. G. Stuart, general storekeeper, Chicago, Burlington & Quincy R. R., Chicago; first vice-president, W. A. Summerhays, general storekeeper, Illinois Central R. R., Chicago; second vice-president, H. S. Burr, superintendent of stores, Erie Railroad, New York City; secretary-treasurer (re-elected), J. P. Murphy, general storekeeper, New York Central Lines, Collinwood, Ohio.

ENTERTAINMENT

Committees of the Railway Materials Association had arranged a program of social events for the entertainment of the ladies and the members. On Monday the ladies took luncheon at the Midway Gardens, making the trip thence by automobile. Monday evening there was a theater party for members and their ladies. On Tuesday evening the annual banquet was held, followed by dancing.

DRILLING SPEEDS AND FEEDS

The subject of the speed at which a drill should run and the feed per revolution is one on which opinions differ and no rule can be given to cover all cases. The ordinary tables published should be considered as guides only and the correct speeds determined for each particular case by good, sound judgment.

It is generally a safe rule to start carbon steel drills with a peripheral speed of 30 feet per minute for soft tool and machinery steel, 35 feet for cast iron, 60 feet for brass, and a feed of from .004 to .007 of an inch per revolution for drill ½ inch and smaller, and from .005 to .015 inch per revolution for drills larger than ½ inch. At these speeds and feeds a good cutting compound is recommended. In the case of high speed drills, the above feeds should remain unchanged, but the speeds should be increased to from two to two and one-half times. With these speeds and feeds as a starting point, maximum results should be obtained by noting the condition of the drill in connection with the suggestions in the following paragraphs.

If the drill chips out at the cutting edge there is too much feed or the drill has been ground with too much lip clearance. A drill split up the web is evidence of too much feed or of improper grinding, and no drill manufacturer ought to be expected to replace a split drill unless a flaw is evident in the break. The failure to give sufficient lip clearance at the center of a drill will almost always cause it to split up the web.

When the extreme outer corners of the cutting edges wear away too rapidy, it is evidence of too much speed.

The best performance of a drill will be obtained when the effect of the work on the tool is somewhere between these two extremes.

The remedy for drills that are properly ground chipping at the cutting edges is to decrease the feed and increase the speed. If a little care is taken to adjust these properly the drill will do as much work as before and have much longer life. Although we have seen 50 point carbon steel drilled with one of our two-inch carbon drills at a periphery speed of 60 feet per minute and a feed of .065 inch per revolution, we do not think this is good practice as we have found in our own work that the majority of cases are better suited to high speed and light feed carried to the point at which the outside corners commence to wear away.

If the correct speed is not obtained in drilling small holes with hand feed the risk of breaking the drills is greatly increased, especially at the moment the point of the drill is breaking through the farther side of the work. This is due to the operator's difficulty in pressing lightly enough on the feeding lever not to give excessive feed to the slow running drills. In English textile shops specializing in the manufacture of wool combs and kindred products thousands of holes as small as .013 inch in diameter (about No. 80 drill) are drilled every day through brass plates 7/16 inch thick. A No. 59 drill is run at about 20,000 RPM, and this is increased to nearly 30,000 when drilling holes as small as .013 inch. Care is taken to see that the point of the drill runs perfectly true, and it is kept sharp by occasionally rubbing on a smooth oil stone. Outside this industry it is a rare occurrence to come across a small drilling machine running at more than a quarter of its proper speed.

For automatic machines where holes do not exceed two diameters of the drill in depth, and under a flood of lard oil, high speeds and light feeds are especially recommended. For holes deeper than this it becomes a matter of getting rid of the chips, and slower speeds with heavier feeds should be used as the bottom of the hole is approached. Always endeavor in automatic drilling to grind a drill so as to get a small compact roll to the chip, and if possible keep it intact the entire depth of the hole.

Variations in the hardness of the material drilled should of course be met by the skilled operator with changes in the speed and feed. This is necessary as the commercial twist drill must be tempered for average conditions, so as to give good results in either hard or soft material. A drill that would give maximum results drilling hard steel would be entirely too brittle to work well in softer and tougher material.

A heavier feed should be used in drilling brass, especially in automatic machines, to insure the chips working out, and if lubricated at all the tool should be flooded with paraffine oil.

To maintain the speeds and feeds here recommended, it will be found necessary to use some good cutting compound, and we advise the following in the order named:

For hard and refractory steel—Turpentine, kerosene, soda water.

For soft steel and wrought iron—Lard oil, soda water.

For malleable iron—Soda water.

For brass—A flood of paraffine oil, if any.

For aluminum and soft alloys—Kerosene, soda water.

Cast iron—Should be worked dry or with a jet of compressed air for a cooling medium.

These recommendations apply equally well to carbon or high speed drills, but it is very good practice to warm the lubricant before using it with high speed tools. Any hard piece of steel is extremely brittle when cold, and high speed drills should never be put to work in that condition; they work much better when warm, often giving good results when the chips are turned blue by the heat generated.—*Drill Chips.*

Since the Last Conventions

Retrospective Analysis of Mechanical Happenings Not Only of the Past Year, but of the Past Years

Since the last conventions—not simply that which has occurred since June 1914, not a chronological record of petty happenings during the last year—but rather what has been the cumulative value of the many years of work and progress of the two mechanical associations, the American Railway Master Mechanics' Association and the Master Car Builders' Association. This is the forty-eighth annual convention for the former and the forty-ninth annual convention for the latter—nearly half a century of continuing progress.

In the light of the history of these two associations, in view of what they have done for railroads in this country, it is only natural that we measure time in our own special field of endeavor by referring to incidents as having occurred "Since the last Conventions." Both of our mechanical associations came into existence at a time when the combination of small local roads into through systems, and the establishment of through-passenger and freight lines, made some kind of co-operative work necessary. For many years these organizations met annually at cities in different parts of the country. The attendance ranged from 40 to 50 members, and there would be from 150 to 200 in attendance including members of their families and representatives of supply manufacturers.

For some years the conventions were not provided with any regular entertainment features, but everything of that kind was private in its nature. Then as the attendance increased and interest in the conventions became more widespread, the local manufacturers and supply dealers in cities where the meetings were held, began to subscribe funds for entertainment purposes. Excursions were given to local shops and points of interest and provision was made for making the time outside of sessions pass pleasantly. At the fifth annual meeting of the Master Mechanics, at Boston in 1872, a surplus of $3,000 from the entertainment fund was presented to the association. This "Boston Fund" was allowed to accumulate for many years and was then invested in scholarships (which are still controlled by the association), in the Stevens Institute of Technology.

The Master Mechanics' Association met in May, and the Car Builders' in June, in different cities, with a week or two intervening, and those who attended both conventions were put to quite a little inconvenience. In 1881 both conventions met the same day (June 14th), one in New York and the other in Providence. In 1878 the Master Car Builders met at Niagara Falls, and in 1882 the Master Mechanics met there. The absence of local manufacturing industries at that place seems to have been the reason for the beginning of a different plan on the part of the supply men. All the concerns represented at the conventions from that time on formed a temporary organization, and "chipped in" to a public entertainment fund. It soon came to be expected that every one would participate and there was little trouble in raising all the funds which could advantageously be used in public entertainment. This, together with the attractions of the popular resorts where the meetings were held, led to a large increase in attendance, especially of ladies and families of members. This plan seems first to have been fully inaugurated at the M. C. B. convention in Saratoga in 1884; and at the M. M. convention at Long Branch the same year.

Inventors and manufacturers had from the first carried models and drawings in their pockets or shown them in their rooms. In 1883 there was a very creditable Exposition of Railway Appliances held in Chicago, and both conventions were held in that city. The advantages of exhibiting appliances publicly became quite manifest at that gathering. Both manufacturers and railway men realized the value of such opportunities. We accordingly find that at the conventions at Saratoga and Long Branch in 1884 there were quite a number of exhibits made in the corridors of the hotels. At Long Branch a Mann Boudoir was shown on the railway track.

In 1885 the Master Car Builders met at Old Point Comfort, for the first time, and the Master Mechanics met at Washington. At the former there were twenty-nine exhibits, which were noticed in the railway papers; and at the latter there were twenty-seven. In 1886 the M. C. B. Association met at Niagara Falls again, where there were eighteen exhibits, and the M. M. Association at Boston, where there were sixteen.

It should be noted that as far back as 1887 some special evening sessions were held during the conventions for the purpose of giving inventors and manufacturers an opportunity to describe their devices and set forth their claims. From these small beginnings, the June conventions have risen from a total attendance of two or three hundred to as many thousands.

There are many who will remember the M. C. B. Convention at Minneapolis in 1887, especially notable for the report on the tests of power brakes for freight trains and the discussion of automatic couplers. There were twenty-six exhibits in the hotel corridors. The M. M. Convention was held at St. Paul the succeeding week. This marked the beginning of the plan of holding the conventions in the same place and one following the other closely in point of time. That year it began to be noticed that the personal interviews and exchanges of experiences in the hotel corridors were about as valuable as the actual sessions of the conventions. The thought and experience of each one was thus made available for all, with a great saving in the matter of useless experimentation and "threshing over old straw." The reorganization of the two associations for increasing efficiency also made marked progress.

We might follow the progress of the Master Mechanics' and Master Car Builders' Associations down to the present time; we might elaborate upon the part which the railway supply manufacturers have played in these annual conventions; we might dwell upon the coopera-

tion between the railroad man and the railway supply man. In fact it has all been the finest example of co-operation that has ever been seen in American life,—a co-operation which has given to the American people the greatest railway systems in the world—a transportation service unequaled and at the lowest known unit of operating cost.

The importance of these two associations is unconsciously recognized in that attitude of mind which so naturally falls into the habit of keeping track of progress by the years from June to June, rather than from January to December. No greater compliment could be paid to our mechanical conventions than this fact. We instinctively feel, as we come again to the annual June meetings, that we are coming to the ending of another year, not the calendar year, not the fiscal year of our own business, but the ending of another year of progress. Each year ending June has recorded the advance made by the railroads in their mechanical departments. We could go back over the published proceedings of the Master Car Builders' Association, of the American Railway Master Mechanics' Association, and tabulate from those written records a most interesting list of improvements in methods and materials, which would show the steps taken in the progress of railroads in their mechanical departments. What was the locomotive at the date of the organization of the American Railway Master Mechanics' Association? Go back for just a moment to forty-eight years ago and remember the size, the capacity, the draw-bar pull, the efficiency of the locomotive of that day. Place it beside the locomotive of 1915 and begin to count up the vast number of improvements that have been made since that time. Space forbids the detailing of them.

Go back to the freight car at the time of the organization of the Master Car Builders' Association. Compare the car of forty-nine years ago with the car of today, its capacity, its size and its equipment. What a tremendous jump, what a vast amount of time and energy and thought has been put into the freight car to bring it up to its present state of efficiency, and yet we are far from being satisfied with it. How different the railroad shop of half a century ago from that of today; and possibly by taking thought of some of the things which have occurred during the life time of these two associations we will come to a better realization of the tremendous work which they have done. And if their work had not been done the American people would not have the right to feel the pride that they do feel in their great transportation systems.

We have not mentioned the passenger car, but consider the conditions of travel, so far as the passenger car is concerned, in the sixties as compared with what it is today. Could we travel to the present conventions with the conveniences given to the traveling public nearly fifty years ago, we would probably have a much higher appreciation of the work of our mechanical associations. There has been progress during the past year—we have advanced "since the last conventions." What this advance has been is not for us to say. We would not anticipate the reports of the two mechanical associations. They will speak for themselves, speak with authority and speak in a way that shall mark still further the progress in this special department of railroading.

"Since the last conventions," however, there has intervened a year of unusual stress and anxiety. It goes without saying that the great European war, the greatest war that has ever been known, has had its effect upon everything in this country, and the mechanical departments of the railroads are no exception to this general condition. It is hardly necessary to refer to the fact that the railroads are still laboring under conditions most adverse. As one railroad man put it to the writer only a few weeks ago—"Railways are too poor to be economical." This is a condition that has been most undoubtedly true "since the last conventions." It is a condition that is likely to continue unless some very radical measures are adopted for the relief of the railroads. It makes a condition most trying for the men who are in charge of the mechanical departments of railroading. We find it absolutely necessary in these days to be extravagant because we are poor, whereas if we had the money we might be economical. No one better appreciates this fact than the mechanical official, no one better knows than he that if we could spend more money upon our cars, our cars would cost us less. This is not a self-contradictory statement. We appreciate the fact that if a car is to give service it must be rightly built, and if it is rightly built it must cost more money than if it is lightly built.

We have had a hard year,—a year that is going to be remembered for some time to come by those who journey each June to attend the mechanical conventions; but there are better times coming for everyone, and the railroad man is going to be included. Prosperity has been side tracked and legislative laws given the right of way, but most of them are going to jump the track and after we have cleaned up the wreckage and got our roadbed in good shape, we are going to give prosperity the right of way and this country is going to have many years of the "best times" ever known.

MANUFACTURE OF SCRAP IRON

The manufacture of scrap iron as an industry has been very largely developed during the past few years. Many consumers are coming to depend very largely on having their scrap iron put into such shape at any outside plant that it can be readily used without further fabrication.

This line of manufacture has been entered into very extensively by the Hyman Michaels Company, of Chicago, at their East Chicago, Indiana, yards, and they have established a well-equipped plant in the St. Louis district, where they are installing a number of shears, acetylene cutting apparatus, and contrivance for sorting, cutting and testing materials.

They have also installed at this plant, which is located at the corner of Adelaide and Bulwer Avenues, a plant for the handling of new and used rails. Some time ago a standard inspection bureau was installed in connection with their rail department, and the result has been highly gratifying.

The Hyman-Michaels Company succeeded to the scrap iron and rail business of the Block Pollak Iron Company several years ago.

The Toledo Terminal is building one mile of track to its main line.

International Railway Fuel Association

Powdered Coal, Fuel Stations, Mechanical Stokers and Coal Storage Among Reports Presented

The International Railway Fuel Association held its seventh annual convention at the Hotel La Salle, Chicago, May 17 to 20, 1915. President D. R. MacBain, superintendent of motive power of the New York Central R. R. at Cleveland, Ohio, was in the chair.

Before starting the technical discussions an invocation was made, and addresses given by President D. R. MacBain and an address by Mr. A. M. Schoyer, resident vice-president in Chicago of the Pennsylvania Lines West. The reports of the secretary and treasurer were also submitted. Mr. MacBain's address was enthusiastic and optimistic. He pointed out the relation of the work of the association to the work of railroads generally.

Mr. Schoyer briefly went over the history of wage arbitrations on railways and their effect on the relations of the roads to their employes. He proposed a method of solving these recurring difficulties through the use of a compulsory arbitration law. As he outlined this law, a commission was to be provided, made up of individuals of high standing who had not been connected either with the railroads or with railroad labor organizations for a sufficient length of time to insure their impartiality. His idea was to make these offices sufficiently remunerative to place the judges beyond mercenary influence, and to make their term of office long enough, and to have their appointment and removal so protected as to give them the greatest possible independence in opinion and decision. Mr. Schoyer held that the interruption of railway service through strikes has so widespread an effect upon the public that it warrants recourse to a law to prevent strikes.

The secretary-treasurer's report gave the membership of the association as 680, and the cash balance at the close of this year's business as $826.65. These reports were followed by the regular technical program.

POWDERED COAL, ITS PREPARATION AND USE

The paper on powdered coal was read by W. L. Robinson, supervisor of fuel consumption of the Baltimore & Ohio R. R. It covered the principles governing the application of powdered coal as fuel in locomotive practice, and gave as the expected benefit to be derived therefrom the following:

1, Ability to realize sustained boiler horse-power; 2, ability to operate locomotives through relatively long periods and distances; 3, entirely automatic manipulation of the fire, no hand firing whatever being required; 4, absence of cinders, sparks and smoke; 5, material reduction in cylinder back pressure through greatly enlarged exhaust passages; 6, savings in the expense of inspection, maintenance and operation through the complete elimination of grates, ash pans, dampers and operating gear, smoke box diaphragms, baffles, nettings, spark hoppers, hand-hole plates, coal pushers, firing tools, squirt hose and like equipment; 7, the advantages of enclosed fuel containers preventing the spilling and loss of coal and its deterioration through being subjected to weather and other unfavorable conditions; 8, more uniform furnace temperatures reducing the liability of flue and firebox leakage; 9, non-requirement of special fuel for firing up; 10, ability to make use of inferior grades and qualities of solid fuel; 11, reduction of heat losses from combustion; 12, lessened liabilities of setting out fires; 13, reduction of time lost in building, cleaning and dumping fires at terminals, and in cleaning flues and smoke boxes; 14, elimination of ash-pit tracks and ash-handling facilities at terminals and intermediate stations; 15, no clogging of superheater units and boiler flues; 16, reduction in the emission of poisonous gases through the smokestack; 17, no cinders, ashes, etc., in ballast, and no burned-out ties; 18, lessened educational and physical requirements of labor for firing.

The discussion showed a great interest in the application of powdered coal to locomotive use. As powdered coal has not been used for locomotives to any except an experimental extent, the points raised had their greatest bearing on stationary practice, but the objections raised seemed to be met point by point by practices that had been worked out to meet the same objections in stationary work.

ANALYSIS OF DEPENDANT SEQUENCE AS A GUIDE TO FUEL ECONOMIES

This paper, by Harrington Emerson, analyzed comprehensively the railroads' losses in fuel under five headings: (1) Administrative Inefficiency; (2) Shrinkage in Quantity Between Purchase and Use; (3) Wastes Due to Poor Design; (4) Wastes Due to Poor Firing; (5) Wastes Due to Poor Running.

These headings were further divided in detail, and suggestions made for their correction. Mr. Emerson gave three points where railroads can strengthen themselves to overcome these losses: First, to become familiar with every process from the mine to the ash pit; second, to build up and educate an organization to deal capably with the subject; third, to secure the proper spirit of co-operation in this organization to insure intelligent activity. The discussion following the paper strengthened Mr. Emerson's position, and brought out the importance of following up the details, which amount to a good deal in the accumulated total.

STANDARDIZATION OF COAL PREPARATION

This paper, by A. C. Adams, president of the Jones & Adams Coal Company, went into the difficulties in the mining industry due to labor disputes, to keen competition, and to what he considered the unfair demands of the coal consumers for sizes and grades of coal which could not be produced in economical proportions. The production of some of the demanded grades of coal automatically necessitates the accumulation of large quantities of other grades for which there is no market. These must be stored pending sale, and are inconvenient both from a storage and from a financial point of view. Mr.

Adams went on to suggest that a closer understanding between producers and users of coal as to sizes and grades of fuel best adapted to different uses would bring about the following benefits: (a) "It would reduce the very large overproduction of coal practically down to meet the demand. The capacity of the mines in Illinois alone is estimated to be nearly one hundred per cent in excess of the demand.

(b) "Standardizing, it will be seen, would reduce the output to a point where the mine would get running time that would greatly reduce the cost.

(c) "A great many railroad cars that are now constantly tied up with unsalable sizes would be released and could be used for any other purpose.

(d) "The operator would not be producing two or three tons of sizes that he has no market for in order to get a ton of the size coal he wants.

(e) "The dealers would require a far less number of sheds for their coal and would, therefore, be able to confine their business to one size of each kind of coal that they carry, and that would be lump coal.

(f) "The railroads for their fuel could use either inch-and-a-quarter lump or mine run, as they deem best, and either of these sizes could be produced in quantities required at all times, for the reason that no unsalable sizes would be produced in order to supply railroad coal.

(g) "It is estimated that with such a reduced number of sizes an even consumption could be secured, and at practically no time in the year would there be any surplus coal that could not find a market. The few sizes would enable the operator to determine the extent of the market and avoid accumulations."

In the discussion which followed, the operators expressed satisfaction in the tendency that had been developed toward the use of powdered coal for locomotives.

SMOKE PREVENTION

Mr. E. W. Pratt, assistant superintendent motive power of the Chicago & Northwestern Ry., next read a paper covering the efforts of the railroads entering Chicago, in conjunction with the smoke inspection bureau, in suppressing the smoke nuisance. Figures presented by Mr. Pratt tended to show that the smoke nuisance in Chicago had been reduced to approximately 41% of what it was in 1910, and Mr. Pratt stated his confidence that conditions could be improved beyond this.

FUEL STATIONS

Mr. H. J. Slifer was chairman of the committee which presented this report, and consideration was given principally to the storage of coal and weighing and measuring devices at coaling stations. Five or six installations were shown to illustrate different methods of storing large quantities of coal. In regard to weighing and measuring devices, the committee recommended that fuel accounting be considered from two standpoints: "First, that of value; it is not possible to ignore losses, shrinking, thefts, and other money values that must be adjusted, but these should not enter into individual performance and should be eliminated and handled by the central office having to do with fuel accounting; second, that of quantity; the committee believes that individual performances and their records should deal with quantities only; the individual coal plant, locomotive and enginemen should be charged with that which it or he receives and credited with that which it or he issues and uses. No adjustments of any character should be included in the published statements showing individual performances."

The committee arrived at the following conclusions:

First. "That the storage of coal at certain seasons of the year, when commercial business is at the minimum, is advisable and economical from the standpoints of insuring a supply during the winter months and that of the efficient use of equipment.

Second. "That no serious consideration need be given to the question of deterioration, but that each coal should be carefully studied to determine the best methods for preventing spontaneous combustion and that it is advisable to store coal from different fields in separate piles.

Third. "That trestles are acceptable for use in storing coal at established plants and at other points where locomotive cranes are available.

Fourth: "That all new mechanical plants should be provided with storage adjuncts.

Fifth. "That individual locomotive and enginemen performance records are indispensable for efficient and economical operating results.

Sixth. "That all coal handled through modern locomotive coaling stations should be accurately weighed or measured, going to and coming from the plant."

THE RELATION OF MECHANICAL STOKERS TO THE FUEL PROBLEM

This report was made by the committee on "Firing Practice," of which D. C. Buell, director of the Railway Educational Bureau of the Union Pacific, is chairman. The report covered the historical phases of the mechanical stoker in both stationary and locomotive service, and a large number of debatable questions concerning the usefulness of the stoker in locomotive service were discussed. The committee reports as follows:

First. "The stoker of today is over 90 per cent efficient. The Pennsylvania record with the Crawford stoker, covering a total of 204,922 trips, including all of the experimental trips during the time the stoker was being developed, shows an efficiency of 83.8 per cent. It can be readily understood that present efficiency is considerably higher than this figure. A six months' record of the use of stokers on the Norfolk & Western shows 97½ per cent efficiency, which makes the statement above that the stoker is over 90 per cent efficient at the present time seem conservative. Roads having a considerable number of stokers in service show a performance of over 50,000 miles per engine failure on stoker-fired locomotives.

Second. "It seems conservative to state that the stoker will show a very satisfactory fuel economy based on ton-mile performance. That is, while it may not show a reduction in the gross amount of coal consumed per trip, it will show that it can haul more tonnage than a hand-fired engine using about the same gross quantity of the same or a cheaper grade of fuel.

Third. "From the coal producers' standpoint, the increased demand for slack coal and screenings for stoker-fired engines will no doubt be of benefit.

Fourth. "The stoker permits general operating efficiencies that would be otherwise impossible. Train loads can be increased by the application of stokers to locomotives where the cost of grade reduction would be prohibitive or where bridge weights or terminal facilities, or

both, might prohibit the introduction of heavier and larger power. On districts where train movement is so frequent as to approach the limit of single or double track capacity the increased speed of trains hauled by stoker-fired locomotives, together with the increased tonnage of such trains, will assist in relieving the congested conditions.

Fifth. "The stoker entirely obviates any question of the necessity for two firemen on large engines.

Sixth. "No complications are introduced by the stoker in the way of detention of power at terminals, engine failures on the road, or in connection with the smoke elimination problem. So far as observation and experience have gone no objectionable features have as yet arisen which can in any way be considered as impairing the value of the mechanical stoker. The stoker lives up to its worth, maintaining maximum steam pressure uniformly when the engine is worked at 100 per cent cut-off or at shorter cut-offs and higher speeds. To sum it all up, the stoker, even in its present state of development, pays and pays well in every case where a real stoker job is indicated."

The discussion confirmed the findings of the committee, and disclosed very favorable sentiment to the locomotive stoker. Mr. W. S. Bartholomew, president of the Locomotive Stoker Company, added an interesting feature to the discussion by suggesting that the lack of success of the first locomotive stoker was due to its use on such small locomotives that it was not necessary, and was therefore not able to work to advantage. At that time the unfortunate idea was gathered that the use of locomotive stokers would reduce the quality of the labor used in firing engines. Of course this idea does not prevail at present, and a large measure of the success of the locomotive stoker is due to the recognition of the fact that highly intelligent supervision of the stoker and the firing process is eminently valuable, and can effect savings in the use of fuel, and added efficiency in the manipulation of the locomotive as a whole. It was pointed out by Mr. Bartholomew that mechanical stokers have been designed with the idea of using screenings and run-of-mine coal, and the question was raised as to whether or not the use of this coal, at about 70% of the prevailing price for the fuel now used, would not equal the savings gained by the use of powdered coal when the cost of pulverizing, drying and handling is taken into consideration. According to Mr. Bartholomew, this matter deserves careful investigation before it is safe to assume that large savings are possible in the direction of powdered coal.

FUEL OIL FOR LOCOMOTIVE USE

This very interesting paper was read by G. M. Bean, Pacific Coast representative of the American Arch Company. The paper covered the subject historically, and went into various characteristic methods employed in this country for using fuel oil for locomotives. The discussion centered around the relation of the fire brick arch to the successful use of fuel oil. Other points raised involved the education of the crews handling the oil-burning engines and the up-keep of the apparatus.

WASTE OF FUEL IN RAILWAY STATIONARY PLANTS AND LOCOMOTIVES

This paper was read by F. A. Moreland, acting for Jos. W. Hays, combustion engineer for G. L. Simonds & Co. Present practices in railway stationary plants were strongly criticised. Specific criticism applies to the employment of cheaper classes of labor in boiler rooms, and the lack of necessary supervision of that labor. Methods were suggested for checking up the efficiency of stationary plant operation. The discussion seemed to strengthen Mr. Hays' contention, and the Smoke Inspection Department of the City of Chicago substantiated many of his criticisms.

STORAGE OF COAL

This report was made by last year's committee, and presents in elaborate detail the results of investigations of a series of committees extending through the eastern, the southern, the south-central, the south-western, the north-central, the western, and the north-western states, including portions of western Canada. Consideration was given to the relative merits of storing coal at destination or of storing at central points. All agreed in advocating the storage of coal as a general practice whereby work at the mines and pressure of business on the railroads could be more economically adjusted in supplying fuel regularly not only to the railroad, but to other coal consumers.

Secretary Hall took up this point by advocating that the railroads store fuel for regular consumers along their lines as well as on their own account, both to assist the mine operators to more even and more economical production, and to secure themselves against car shortages and congestion.

FUEL CONDITIONS IN SOUTH AMERICA

This paper was read by James W. Hardy, sales agent of the Western Kentucky Coal Company, New Orleans, La. Mr. Hardy reports that there are many serious difficulties to be overcome in extending the coal trade of the United States to South American countries. Among these are the well established European agents, particularly those of England, financial connections and arrangements for credit, and the advantage held by Australian mines in laying down coal at South American points cheaper than is possible from the United States.

MISCELLANEOUS REPORTS

Mr. M. C. M. Hatch presented a report on drafting of locomotives. This report had to do with the wide variation in the practice of different roads in the construction and arrangement of ash pans, grates, dampers, baffles, netting, and nozzles.

The second miscellaneous report was presented by J. G. Crawford, fuel inpector of the Chicago, Burlington & Quincy R. R., on arrangements which have been made with the University of Illinois for the use of their locomotive testing plant in making tests to determine the relative value of different sizes of coal from the same mines.

The next report, by Mr. T. J. Lowe, fuel agent of the Canadian Northern Ry., Winnipeg, Man., took up the matter of devising means by which forms for fuel accounting on the several roads could be standardized, and the number of forms reduced.

Mr. A. W. Perley, special representative of the mechanical department of the Union Pacific (O. W. R. R. & N.), addressed the convention on the matter of

stimulating railroad employes to obtain more intimate knowledge on the financial and legislative status of the railroads in this country. He showed how this would be of advantage in arousing a degree of interest that would benefit the railroads in combating the wave of restrictive legislation that has been so seriously depressing the railroads during the last few years.

Reports were received from the temporary committees on constitution and by-laws, auditing, thanks, and resolutions.

The following officers were re-elected:

For president, D. C. Buell, chief of the educational bureau, Union Pacific, Omaha, Neb.; first vice-president, J. G. Crawford, fuel engineer, C. B. & Q., Chicago, Ill.; second vice-president, E. W. Pratt, assistant superintendent motive power, C. & N. W., Chicago, Ill.; and third vice-president, W. H. Averill, general superintendent, B. & O., Staten Island, N. Y.

The members of the executive committee are: W. C. Hayes, Erie; M. C. M. Hatch, H. B. Brown, A. G. Kinyon, and T. J. Lowe. By the provisions of the constitution of the association, the retiring president, D. R. MacBain, becomes a member of the executive committee to serve for a three-year term.

In balloting to determine the choice of cities in which to hold next year's convention, the majority of votes were in favor of Chicago.

GOLF TOURNAMENT

The Second Annual Golf Tournament at the Sea View Golf Club, open to members of the A. R. M. M. A., M. C. B. A., R. S. M. A. and official registered guests, will be held on June 13. The tournament will consist of two contests run simultaneously, one an 18-hole medal play handicap, the other an 18-hole kickers' handicap. Loving cups will be presented to the three low men in each contest.

The winning score in the kickers' handicap will be between 71 and 76, inclusive. Each participant will have the privilege of selecting his own handicap prior to starting, with a view of securing a net score from 71 to 76, inclusive. Net scores under or over 71 to 76, respectively, will be disqualified. In case of ties in either the 18-hole medal play handicap or in the 18-hole kickers' handicap, additional rounds will be played by those who are tied, either on Monday the 14th, or Tuesday the 15th of June.

The Sea View Golf Club is a private course, and it is through the personal invitation of its president, Mr. Clarence H. Geist, that the mechanical associations are privileged to hold their tournament at this club. No entrance fees for the tournament will be charged by the association, but the club will levy the usual greens fee of $1.00 per day per person. Entries for both tournaments can be made to any of the members of the Golf Committee prior to June 13, or can be made at the first tee on June 13, prior to starting.

The Chicago Great Western is in the market for five switching locomotives.

The Cuba Railroad has ordered 15 locomotives from the American Locomotive Co., according to report.

The French government is in the market for 25 to 50 locomotives for the Paris-Orleans line, it is said.

GRINDING NIGGER HEAD RINGS

By H. C. Spicer.

A corner air motor can be used to grind-in nigger head rings, where the front flue sheet is not removed and the quarters are cramped. By reference to the accompanying sketch it will be observed that a small rope or chain can be used with a piece of common board as a lever to help hold up the weight of the motor. The time and labor that this method saves over the old

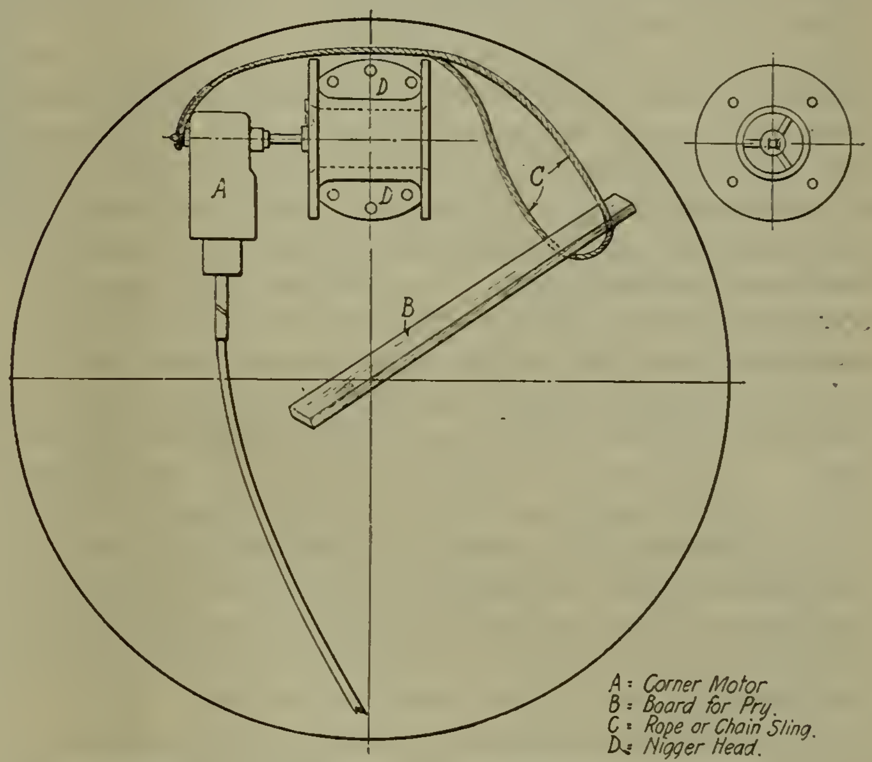


Diagram Showing Use of Corner Air Motor.

method of having this ring ground-in by hand can be readily appreciated. In addition to this, the air motor method is easy and comfortable for the operator. Experience seems to show that the worst seats are always those most inaccessible. This method will make any joint easy to grind and a perfect job can be had in a short time. In fact, a good joint can be ground in just as short a time as though the nigger head were out on the floor.

This method has been so successful that all of our throttle valves and steam-pipe joints are ground by the use of an air motor and even dry-pipe joints to flue sheets by coupling a corner motor to the front flue sheets. This proves quite a saver of time and labor.

MAKING AND REPAIRING SPRINGS

By Horace T. Jones.

I remember twenty years ago when the old spring maker would come down to the shop after night and fill the tempering tank with powders and various compositions. We young fellows thought he was a wonderful man, and indeed he was, so to impress the men in charge. Everyone believed that there was in his possession some wonderful knowledge of a mysterious composition that would make springs hold up in service. My own long practical experience since has led me to believe that his art was largely in his impressiveness. I make no mystery of the proper making and repairing of springs, and am glad to hand along the knowledge gained by years of work. The young fellows who are coming up can make good use of this experience.

The first step in making new springs is the selection of the proper steel, which I believe should contain about 1 per cent carbon. There are two ways of cutting this steel to the proper length. In large up-to-date shops the steel is sheared off in an especially constructed machine. The blades for this shear must be so arranged that they will meet along the entire edge at once. This construction breaks the steel clean and straight. In a smaller shop the steel can be nicked with a keen cold cutter and sledge on one side only. The bar is then turned over and the nicked plate is extended over the edge of the anvil about two inches, a cold chisel placed directly over the cut, and one sharp blow snaps the steel clean and straight every time. For the sake of economy several railroads today do not draw or taper the points of the spring leaves. However, drawing the points of the short leaf assists materially in putting on the band and saves time and labor. In repairing old springs it is economical to use the old scrap leaves for short leaves and cut off new steel only for the long and main leaves.

The next step is putting on the tit in the center to hold the leaves together. This can be done either in a power press or with top and bottom tools on an anvil. The steel is then heated, and this operation depends largely on the facilities of the shop. Up-to-date shops use oil furnaces and gas is also used quite extensively in some localities. I have worked in one shop where neither oil nor gas was used, but the waste coal and cinder heaps from the blacksmith's fires were used as fuel.

The springs can be set in two ways. Some prefer to use rolls and others use the fitting tongs. Having used both, it is my opinion that a smith and helper with two pair of properly constructed fitting tongs can do more work than a set of rolls. I myself have set an average of 120 plates a day in nine hours.

The tempering bath should consist of an iron tank to contain the oil, and its capacity should be approximately 30 gal. Surrounding this oil tank should be a wooden tank, filled with water, of sufficient capacity to float the oil tank, and a stream of water should come in at one end of the tank and escape at the other to insure keeping the oil cool. I have also seen the use of two jets of air through the oil from opposite sides, but this has not proven as successful as the use of a water jacket. There is a difference of opinion as to the best oil to be used for tempering springs. I used raw linseed oil, as it is non-combustible and is thin and drains off the leaves quickly, saving time and oil. The leaves should be drawn to about a blue, or until the spring is dotted with blue specks. The points should be kept soft to avoid their breaking, the pad of the end of the main leaf should be untempered, and the short leaf should be soft throughout.

The spring should now be arranged for the band. The main leaf should be placed on the face plate, curved side up, pads down, and a mark made on the edge with a piece of crayon at the center of the spring. The next leaf should be placed on top, and so on until time to put on the short leaf. A mark should also be placed at the edge of the center of the short leaf. A square placed on the face plate, tongue up, can be used to line up the bottom and top leaves; and then a mark should be placed two inches each side of the center line on the main leaf and on the short leaf. These marks will give the width of the band and the spring will be absolutely square.

A heavy screw clamp should next be placed as near the center of the spring as possible, and made tight. When this is in position a U-shaped screw clamp made of 7/8" square rod should be tightened down hard, just outside of the line of the band of the spring. The screw clamp in the center should then be removed and the springs should all be carried to this point before the bands are placed in position.

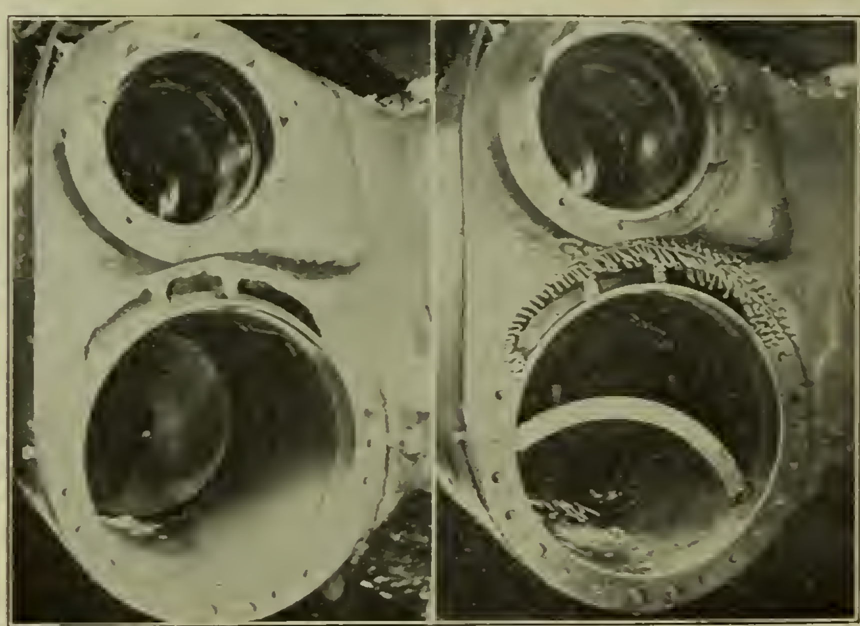
The bands can be heated together, and the manner of shrinking them on will depend upon the facilities of the shop. They can be put on either with a press or by means of a sledge. They should be shrunk very tight, as the band is the life of the spring. The most up-to-date machine that I have seen was a press arranged with four V-blocks, which tightened the band on the spring from all four corners at one operation, requiring only about one minute for each spring after the band was slipped on. A stream of water was played on the blocks sufficient to cool the spring, which was then lifted out of the press with a crane and dipped in a tank containing a quick-drying solution of paint. The spring was then ready for the engine or the stock rack.

REPAIRING BROKEN CYLINDERS BY THE ELECTRIC WELDING PROCESS

By Joseph Grine.

The following method for repairing broken cylinders by the electric welding process has been in use at the Depew shops of the New York Central for the past three years, during which time 60 cylinders and valve chambers on all sizes of power have been repaired. These breaks have occurred in all manner of places on the cylinders and valve chambers, and it would have been necessary to renew the majority of them had not this method of electric welding been available.

In August, 1913, engine 3144 came to shop with the left hand cylinder broken over the three steam ports, a space of about 36 in., with the cylinder bushing still intact. This is shown in the first illustration. The second illustration shows the cylinder drilled and tapped for 1/2 in. studs. The crack is first cut to a "V" shape at an angle of about 45 deg. and half-inch studs placed



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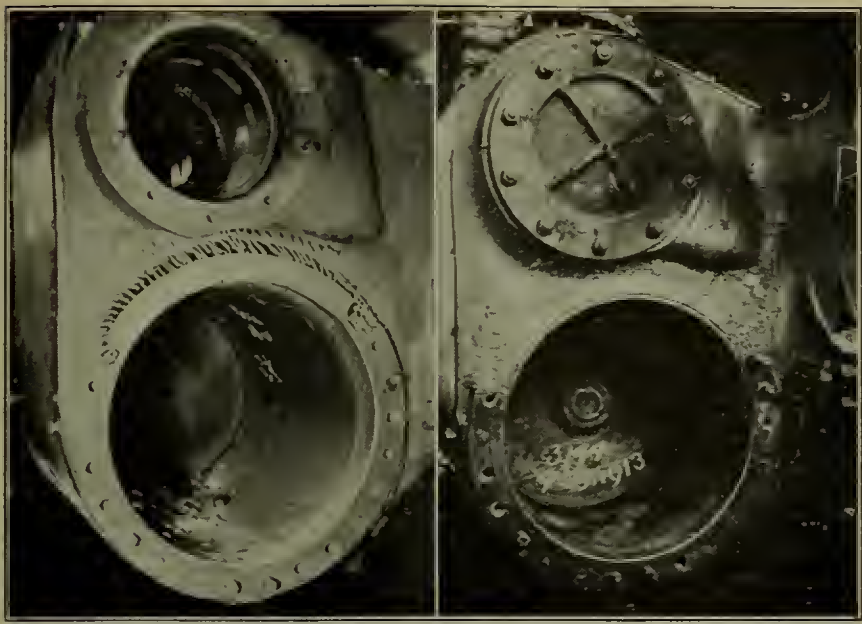


No. 3. No. 4.

on each side of the "V" about 1 or 1¼ in. apart. It is not necessary to let the studs project over the cast iron more than ¼ in. A good experienced operator finds little or no trouble in repairing cylinders or valve chambers with this method. The reason for studding the cast iron is to afford, in the steel or iron studs, something suitable on which to anchor the electric welding. It will be seen that the steel or iron studs placed in the cast iron afford a much better surface on which to weld than would be offered by the cast iron alone. The second illustration shows a quarter circle of 2¼x2½ soft steel which has been faced off and bored to fit the radius of the cylinder. The back part is beveled to form a scarf. This quarter circle is placed on top of the bushing as shown in the third illustration. The electric welding starts on top, gradually working the metal down into the circle, avoiding by care the closing of steam ports. The fourth illustration shows the completed repair as far as the electric welding is concerned. The soft-steel circle inserted on top of the bushing affords a solid metal for the cylinder head studs.

This is one of the largest and most difficult jobs we have done in the line of repairing cylinders with the electric welding process. This engine has been in constant service since Oct. 1, 1913, when the repair was made, and has shown no signs of weakness at this point.

OVERCOMING DRAFT DIFFICULTIES IN SUPERHEATER LOCOMOTIVES

By P. E. McIntosh.

To secure even burning in locomotive fire boxes, the foreman must rely very largely upon information from the engineman as to how the engine burns her fire.

Every superheater engine does not have reflecting plates, but all have lift pipes. If an engine that has lift pipes burns her fire next to the flue sheet, the lower lift pipe should be dropped one inch. If the engine burns her fire next to the door sheet, the lift pipe should be raised one inch.

On superheater engines having reflecting plates with lift pipes, the lift pipes should be regulated as stated above. If this will not overcome the difficulty and the engine still burns her fire next to the flue sheet, the reflecting plates should be raised not less than one inch. If the fire burns under the door, the plate should be lowered one inch. Lift pipes should always be regulated opposite to reflecting plates.

By regulating the draft in this manner we are able to save two or three tons of coal on a round trip, and with the number of engines in this terminal the total saving amounts to 75 tons of coal a day.

THE EQUIPMENT DEPARTMENT OF A RAILROAD *

By F. W. Brazier.

Superintendent Rolling Stock, New York Central R. R.

The equipment department of a railroad is that which has charge of the construction and maintenance of the locomotives and cars used for the movement of the traffic of the railroad, including the operation of the shops, round houses, and other facilities provided for the maintenance of the equipment. On many railroads there is a similar department, known as the marine department, having charge of the floating equipment, such as ferry boats, tugs and other lighterage equipment.

The equipment department is in charge of a staff officer, who is assisted by subordinate officers in direct charge of the work in specified districts. On the New York Central east of Buffalo there are two general officers—a superintendent of motive power in general charge of the locomotive equipment and the shops, round houses and other facilities, who has two assistant superintendents of motive power; a superintendent of rolling stock in general charge of the car equipment and the various facilities, such as shops, repair branches, etc., for the maintenance thereof, who has two assistants called district master car builders. This officer also has charge of the gas manufacturing plants and other facilities for the lighting of the passenger train equipment, the car cleaning forces and the wrecking equipment. On the New York Central west of Buffalo both branches are in charge of one staff officer, with subordinates similar to the line east.

The electrical equipment, locomotives and cars, are under a separate staff officer, the superintendent of electrical equipment. There is also a mechanical engineer, who is in charge of the designing of equipment, the preparation of plans and specifications and standard maintenance practices. On the New York Central we do construct a limited quantity of new equipment, such as all steel dining cars, baggage cars and some freight cars.

Most railroads use their own shops but little for the construction of new equipment, as these facilities are well taxed in the maintenance of the existing equipment, including the general rebuilding. The new equipment is, therefore, as a rule, purchased in a completed form. The railroad, however, through the placing of competent inspectors in the builder's plant, exercises a close check to see that the plans and specifications are closely followed and that the workmanship is up to the required standard. This makes it necessary to send samples of certain materials to the company's laboratory for analysis and the careful inspection of other materials to see that they are up to the standards as called for in the

*Delivered at the Railroad Men's Christian Association, April 14, 1915.

specifications; also to place inspectors to watch the assembling of the parts to insure proper workmanship.

In the operation of the railroad the equipment department has an important duty in the matter of inspection; since the locomotive is inspected each time it reaches a terminal and the necessary work done so the locomotive will be ready for service when required by the operating department. The passenger and freight train cars are also inspected on arrival at the terminals, and any cars having defects which affect the safety of the service are immediately sent to the shop or repair track for attention before they are permitted to perform further service. When the train has been made up for movement from a terminal, the cars are given another inspection in order to determine whether any defect has originated in the yard switching movement which affects the safe operation, and if so the defect is repaired or the car taken out of the train. When the road engine is attached the air brakes are tried under the conditions which prevail when the brake is used in the road, and any defective condition must be remedied before the train is permitted to go forward. I speak of these details to show you what care is taken to have the equipment in proper condition and the duty which devolves on the equipment department in connection therewith, for a train cannot proceed from a terminal until the car inspector has determined that it is in good condition.

Locomotives are sent to the shops as soon as possible after they have performed a specified mileage; this is approximately 60,000 miles on all classes of steam locomotives, except on the large passenger engines, known as the Pacific type, on which a mileage of approximately 120,000 is obtained between shoppings. The passenger train equipment is shopped for general repairs based on its physical condition and the condition of the exterior finish, i. e., when the varnish on the exterior is perished to an extent that the paint is without the protecting coats of varnish, it is necessary to shop the car for repainting, as the paint will deteriorate very rapidly when thus exposed to the weather. On the freight equipment the shopping for general repairs is based on the physical condition of the car.

Under this plan, the passenger car will get to the shop for general overhauling at least once in every eighteen months, this being dependent on the class of service in which the equipment is used. Likewise the freight car will get to the shop for general repairs at least once in every four to five years. The equipment is, of course, repaired as may be required between these general shoppings. These repairs which can be attended to without sending the car to the shop for extensive work are called running repairs.

The equipment department of the New York Central has approximately 18,300 employees, with a pay roll amounting to about $16.000,000 per year. When you consider that the total number of employees on the New York Central is 180,000 you will appreciate what part of the great army is classified as the equipment department—approximately 10 per cent. These figures have been given with a view to bringing to your attention the part that the equipment department has to do with the operating of a railroad and to give you some of the points which, to me, bring out the fact that we, the employees of railroads, are privates in a great and necessary army for the transportation requirements of the country, and have our time well occupied in doing our part to keep the equipment in safe and sanitary condition for the transportation of the millions of passengers who use our line during each year, and also to keep the freight equipment in condition to deliver the shippers' goods on time and in good condition at the prescribed destination.

PORTABLE HYDRO-CARBON OIL-HEATER

By Frank J. Borer

The constant increase in all-steel rolling stock demands various devices for economically repairing damaged parts. The oil heater described herein has been found useful and its construction is so simple that any shop

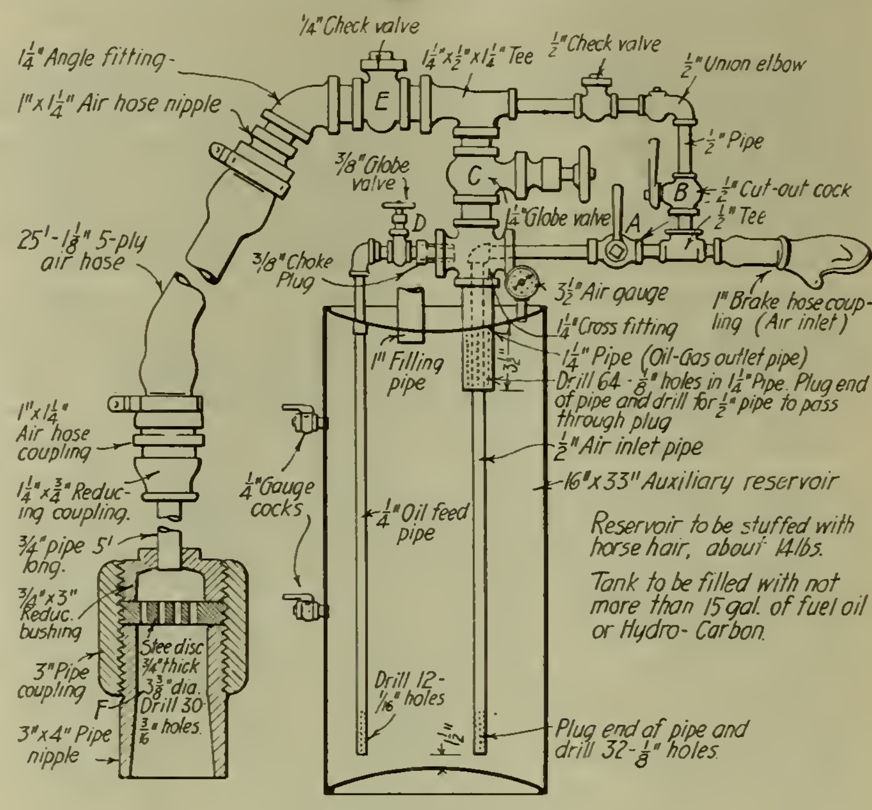


Diagram of Oil Heater.

may construct one at small cost. Sufficient second-hand material to fit up one or more may be obtained in almost any shop.

This heater is especially adapted to heating bent-end sills, side sills, angle irons, braces, etc., to repair them with scarcely any dismantling or removal from the car. It is also useful for pre-heating in oxy-acetylene, electric, or thermit welding.

One of these heaters can likewise be used to good advantage in a wheel shop for removing tires from wheels and for softening the slid flat spaces on steel or steel-tired wheels, thereby saving tire metal when turning.

The heater is safe and the flame can easily be regulated to suit the work. If desired a flame 5 ft. long and about 5 in. in diam. may be obtained, and the heat can be concentrated just where wanted. The heater is designed to use as fuel a hydro-carbon oil, which is a by-product of the Pintsch gas plant and which has excellent heating qualities. Moreover, the heater is so constructed that fuel oil may be used with equally good results.

Referring to the sketch, compressed air is admitted by opening cock A. From there the air will pass down through the ½ in. pipe and the small holes drilled near

Portable Hydro-Carbon Oil Heater.

the end of it into the reservoir. The quick rise of the air to the top of the reservoir is temporarily arrested by the horse hair, thus changing the air to a gaseous vapor or oil gas.

The gas then passes through the small holes drilled in the 1¼ in. pipe, thence through valve C and check valve E into the air hose, and from there to the burner F, where it will ignite as soon as lighted. The size of the flame is adjusted by means of cock A and valve D, the color of the flame by means of cock B.

If hydro-carbon is used a perfectly blue flame can be obtained, and if fuel oil is used the flame will be white. The writer designed this style of heater with a view to overcoming various defects of the heaters formerly used and it gives entire satisfaction.

The Chicago, Rock Island & Pacific has asked for prices on five thousand 40-ton box cars. As soon as estimates are received the receivers will ask permission to issue receivers' certificates.

The American Locomotive Co. has taken an order for small locomotive parts for the Serbian government.

The Western Maryland is in the market for ten locomotives.

The Chicago & North Western has ordered 2,000 box cars from the Western Steel Car & Foundry Co. This road has also asked for bids on 10 coaches and 3 smoking cars.

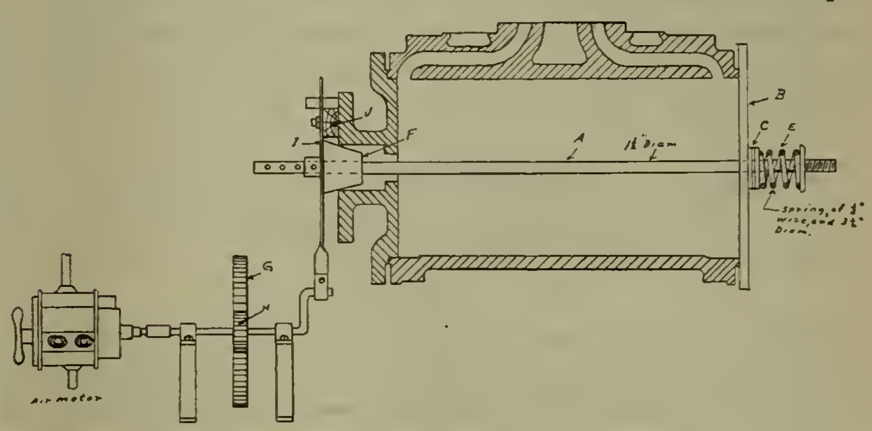
The Chicago Elevated Railways have placed orders for 122 steel cars with the Cincinnati Car Co.

The Pennsylvania has given an order to the Juniata shops to construct fifty Mikado locomotives equipped with superheaters.

GRINDING CYLINDER HEADS

By V. T. Kropidlowski

The practice of grinding back cylinder heads is quite universal, and an apparatus that will reduce the time required to grind in a joint will be welcomed by shop superintendents. An inexpensive device has been perfected by a gang foreman in one of the western shops,

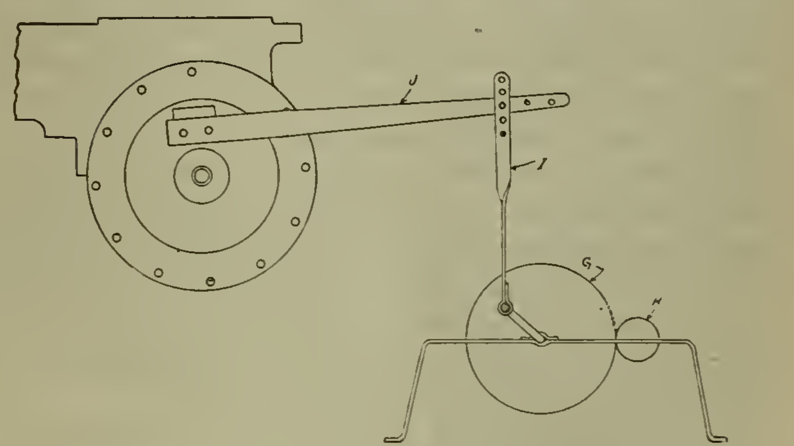


Cross Section of Cylinder-Head Grinder.

which has been in service for about a year with a very satisfactory record.

The cross section shows the tool assembled ready for operation. A rod *A* is inserted through the stuffing box of the back cylinder head and extends through the cylinder to its front, where a common bar of iron *B* is secured to two diametrically opposite front cylinder-head studs, the bar having a hole for the rod to pass through its center. The rod is threaded at the end that goes through the bar *B*, and three brass disks *C* are slipped on this end. These constitute a bearing for the spring *E* that furnishes the required tension for keeping the cylinder head against the joint when it is being ground. A nut, not shown on the end of the rod, is used to keep the cylinder head in place and for varying the tension in grinding, to suit the conditions.

At the cylinder head end a plug *E* is slipped over the rod *A*, tapered to fit any size of stuffing box. Several



Elevation of Cylinder-Head Grinder

holes are drilled through the rod, for adjusting the length of the device to the length of the cylinder. A pin is inserted through the plug *F* in one of these holes, and the final adjustment is made by the nut at the front end.

The end view shows gears *G* and *H*, which have been taken from a discarded windlass of a hand crane, and are mounted on 1 in. shafts, which have for their bearings babbitted boxes, also taken from the old windlass. The boxes are secured to a frame made of ⅝x2 in. flat bar iron. One shaft has a crank, bent at one end, to which is connected the rod *I*, which operates the wooden lever *J*. The lever *J* is attached to the cylinder head by

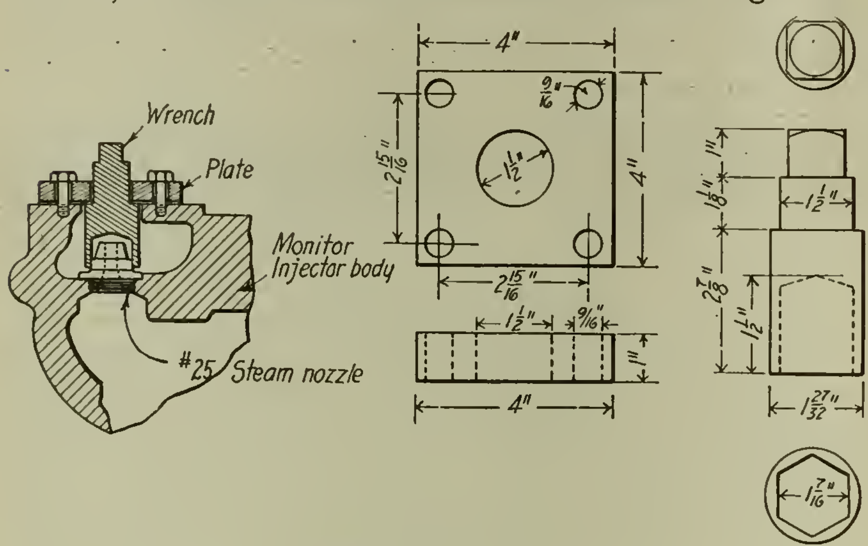
two of the studs of the gland. An air motor drives the shaft of the small gear *H*, and the crank on the shaft of the large gear *G* imparts an oscillating motion to the cylinder head, by means of the rod *I* and the lever *J*.

The gears have a 1¾ in. face, and the large one is 18 in. on the pitch diameter, the small one 5 in. The oscillating motion has been used because it was found that a continuous rotary motion on account of the weight of the head tended to grind the lower wall of the cylinder. By the oscillating motion uneven grinding is nearly overcome by the upward thrust.

JIG FOR REMOVING THE No. 25 STEAM NOZZLES

By F. W. Bentley, Jr.

The No. 25 steam nozzle of the Monitor injector is sometimes very difficult to remove, more especially if the length of time it has been in the body has galled the threads, and the action of the water or other agencies has rounded the hex portions of the nozzle body on which a socket wrench is placed or anchored. If the hex portions are even slightly rounded it is difficult to hold a bar socket wrench down to start the nozzle. If the wrench slips up a number of times, the nozzle generally has to be chipped out thru the throttle bonnet or yoke opening from the other side.



Construction of Jig.

The sketch illustrates a simple wrench and jig which looks quite like any socket wrench made for the purpose. The plate, however, makes it more efficient. If the nozzle hex is slightly rounded the plate will hold the wrench down in place in almost every case until it has been revolved a turn, when it is generally loose enough to remove by the socket wrench alone.

From observation of a considerable number of injectors passing through the shop for repair, it will often be found that this nozzle is frequently neglected in renewal, presumably because of the difficulty in removing it, while the rest of the tubes have been changed from time to time. The jig is quickly set in place, and is a time saver on ruptured or excessively worn nozzle hex portions.

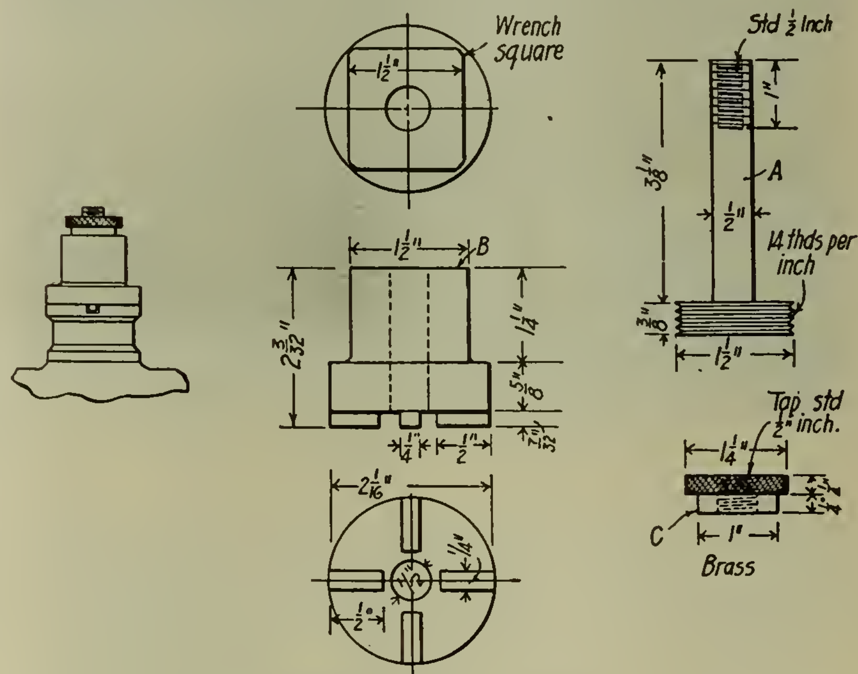
The Boston & Albany is having the American Locomotive Co. convert 10 Consolidation type locomotives to Mikado type.

The Cold Blast Transportation Company is reported in the market for 300 refrigerator cars.

WRENCH FOR REMOVING THE GLASS CASINGS OF BULL'S EYE LUBRICATORS

Bulls-eye glass casings of the circular type, with four slots in the top to engage a suitable wrench, are often very hard to remove from the body of the lubricator. The ordinary slot wrench is hard to keep in position if some of the slots have been rounded or ruptured. Frequently a hammer is used on the wrench to start the casing and the thin walls are torn or spread and the somewhat expensive casing ruined.

The illustration shows a wrench for removing these casings easily and with perfect safety. The spindle A is run down into the casing in the aperture filled ordinarily by the follower. The wrench or lug portion *B* is then dropped over the spindle and drawn to the casing by the small brass nut *C*. The wrench portion is now held squarely to the casing and a wrench suitable in size to start the most obstinate casing can be safely used without injury, as the force on the lugs is evenly distributed.



Details of Special Wrench.

The parts necessary to construct this jig are easily made and its use makes it much easier to draw up leaky casings in the roundhouse. Many good casings are ruined by hasty attempts to get them tight in the body of the lubricator. For stripping a lubricator in which the casings have become tight because of corrosion and heat the wrench is also very convenient.

CUTTING GEARS ON SLOTTER

By E. C. Gaines

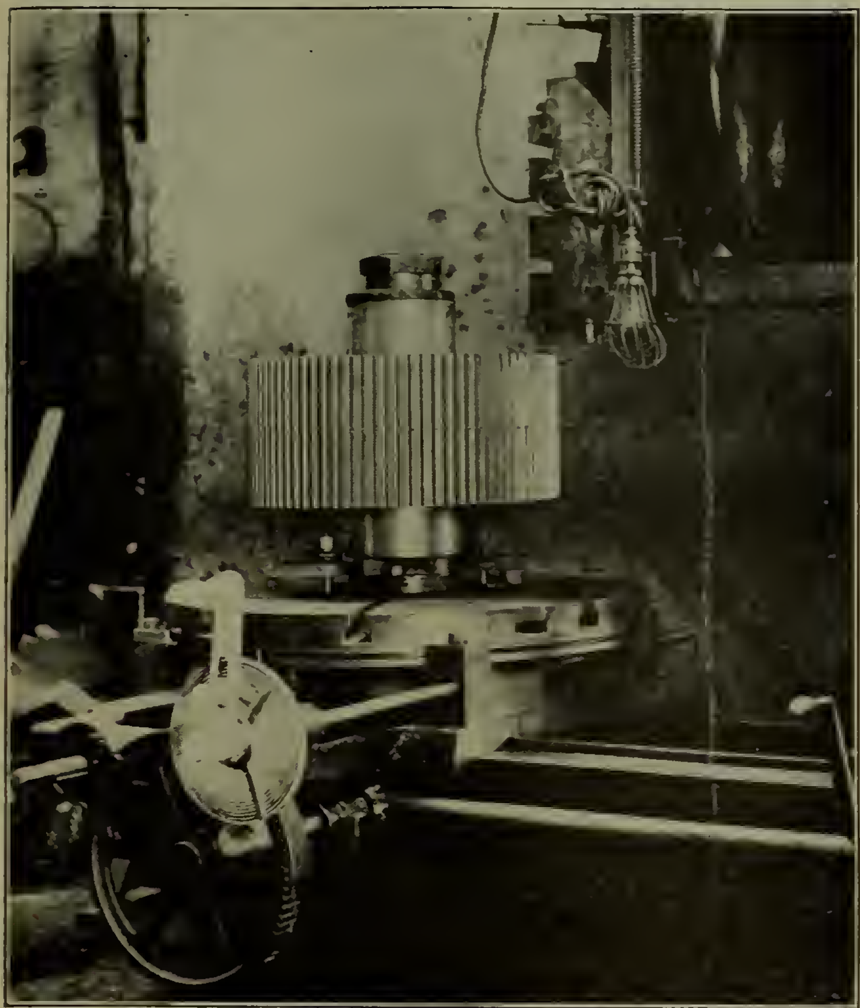
I recently had to make a pair of gears with 2 in. circular pitch, one of them 43¼ in. in diameter of cast iron, the other 11¾ in. of forged steel. We had no 2 in. circular pitch cutters, and could not swing the 43 in. wheel in our milling machine.

After looking the situation over, a dividing head was gotten out to fit on the circular feed handle of a slotter. The bracket carrying the shaft was removed from the machine and a thread chased on the outside of the boss. A sleeve was fitted to go over the shaft and carry a standard index plate, making the plate stationary.

A handle with a sliding lock pin was securely fastened to the square end of the shaft, with two safety set screws. The ratio of the worm gear on the slotter table is 144

to 1, so it is only a matter of dividing 144 by the number of teeth to be cut and selecting a plate to take care of the fraction.

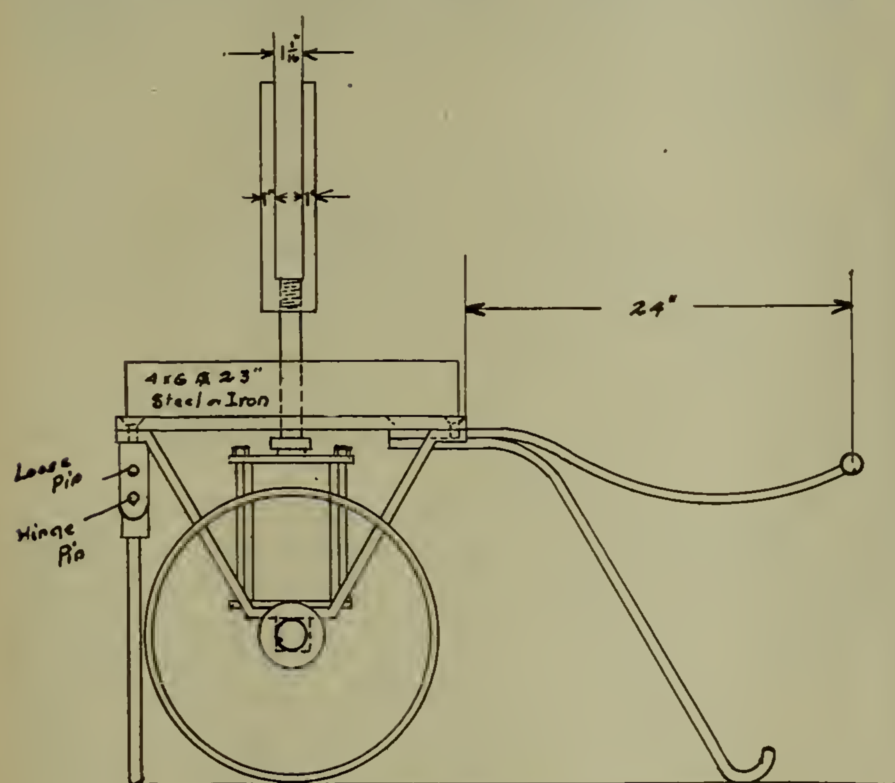
I find the device very useful in railroad work, as it



Large Gear on Slotter.

is much quicker than the milling machine, and every gear is an odd job. The two gears shown in the illustration have 87 teeth, 4 pitch, and were cut in less than half the time required on a milling machine. But two tools are required, a roughing and a forming tool.

This device can be made in any railroad shop for a few dollars, by drawing to fit any slotter, and it at once puts the shop in position to cut any spur gear, internal or external teeth, from 4 in. to 6 ft. in diameter, as accurately as the best gear cutter. Railroads are using more gears now than ever before, and a crane out of commission while a new gear is being ordered from the manufacturer is a serious matter.

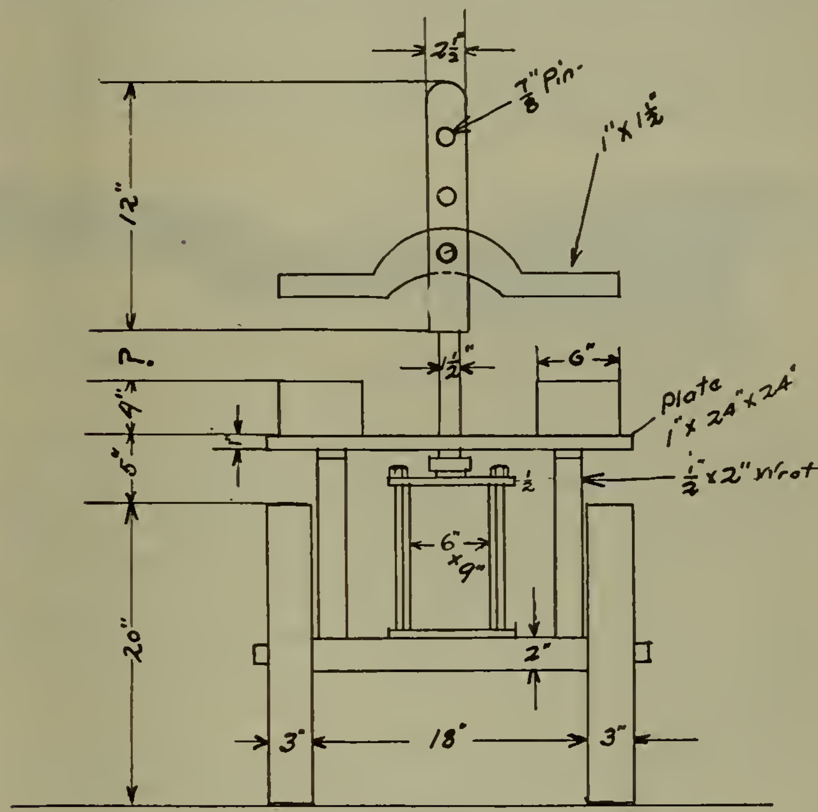


Side View of Portable Pneumatic Clamp.

PORTABLE PNEUMATIC CLAMPS FOR SHOES AND WEDGES

By P. J. Young

A pneumatic clamp for the use of the shoe and wedge man is a most useful tool in the shop. The clamp is portable, mounted on its own truck, and was constructed entirely of second-hand or scrap material, the cost of construction and material being very low. The face plate is made of two pieces of old bridge plate riveted together. The riveting blocks are the same as we formerly used, held in position by two dowels which are screwed into



End View.

the face plate. The man moves the machine to the engine upon which he expects to work and it is not then necessary for him to leave the engine again for the use of a vise, as the clamp serves him as a vise for all purposes. We have a double air connection on the machine and all riveting is done with an air hammer, which is an additional saving over riveting by hand. The sketch of the machine shows the more important dimensions, but these may be varied to suit the material at hand.

EXCHANGE OF TOOLS

By Geo. T. Rohrback.

M. C. B. Jacobs, Dold Packing Co.

In your April number "Railway Storekeeper" requested to know how others keep check on tools. Here is the method used by our company:

Tools given to each repair man are charged to his payroll number at actual cost to the company. No deductions, however, are made in his pay check if, when leaving the company, the repair man checks back to the storeroom all tools drawn. In case the man requires a duplicate tool the old one must be returned in exchange for the new. Should it be found that tools are lost or broken through the carelessness of the workman, the cost of the tool is deducted from his payroll. No tool can be drawn from storeroom by a workman without an ap-

proved order from his foreman in order to guard against unnecessary tools being carried in a department where they are not required.

This system requires very little extra time, and from our experience has done more to make men realize the necessity of taking care of tools and their value than all the instructions ever issued by their foremen.

FORGING LOCOMOTIVE FRONT SECTION FROM SCRAP IRON

By Paul H. Cain

Scrap iron consisting of old brake levers, rods, transoms, equalizers, side bearings, brake beams, bolts, and other parts of locomotive and car equipment, which cannot otherwise be reclaimed, can be forged into suitable billets for making parts of locomotive frames, connecting

Finished Locomotive-Frame Section.

rods, and other similar equipment. The scrap iron is sheared to suitable length to permit making it up in piles 18 in. square, which wil contain approximately 275 lbs. of iron. The furnace is charged with this iron, with the aid of a crane, a flat bar being used. A 2-in. round iron bar is heated to the proper heat and welded to the pile after it is taken from the furnace. This bar serves as a handle.

The furnace is charged with 11 piles of 275 lbs. each at a heat. The production is 55 slabs per furnace in 9 hrs. For making large billets these slabs are piled upon one another according to the size required and welded into refined iron. The billets can then be forged into any desired shape.

For making a front section for a locomotive frame, 20 slabs are used, 10 slabs at a heat, which make two slabs 6 in., by 26 in., by 6 ft. The slabs are then piled together,

275-lb. Piles of Scrap Iron.

Slabs Made from Scrap Iron.

welded and forged into the required shape for the frame front section. Extra metal is left on the front section at the point B, for welding at this point to the main section. After being forged to the proper shape this section is machined to the proper dimensions as shown on the working drawing.

VALVE PROPORTIONS

By George W. Bashaw

Many volumes have been written on valves, and if I did not propose to treat the subject from a comparatively new angle, there would be no good reason for this article.

It is in human nature for men after having used a certain device for years, to view it complacently and to feel that it is perfect. We can not escape our environment, past teachings, and practices. We cling tenaciously to the old because we don't know any better or fear to risk a change. In this respect the mechanical department of most railways does not differ from the capitalist, possesing all his conservatism and timidity,—bearing the evils they have rather than fly to those they know not of.

The ever increasing demands for greater efficiency and power in our locomotives, due to higher operating expenses, have brought to our attention many deficiencies heretofore overlooked. While we have met this demand by enormously increasing the power of the machines, most of us still refuse to entertain any changes in the valve proportions used by our forefathers. In our scramble to get correct grate, boiler, and cylinder ratios, the valve controlling the distribution of this great power has received scant attention.

Modern engines are now equipped with a type of valve gear having a fixed lead at all points of cut-off, and it is this type with its possibilities which should receive our attention. Engines with Stephenson gear rarely had more than $\frac{1}{16}$-in. lead in full gear, being set more generally line and line. When Walschaert, Baker, and other gears came into use, we cautiously went to $\frac{1}{4}$-in. lead in order to secure the same port opening at working cut-off given by the Stephenson motion. Any

more lead was apt to cause trouble in starting the train due to admission taking place long before the piston reached dead center. Now bear in mind that in Stephenson gear days cylinders were rarely over 22-in. in diameter; now they have grown to 31 in. in simple engines. Where a port opening of ½-in. at working cut-off may have sufficed for a 22 in. cylinder without undue loss in pressure due to insufficient port, the 31 in. cylinder would require a 1 in. port. Again, the

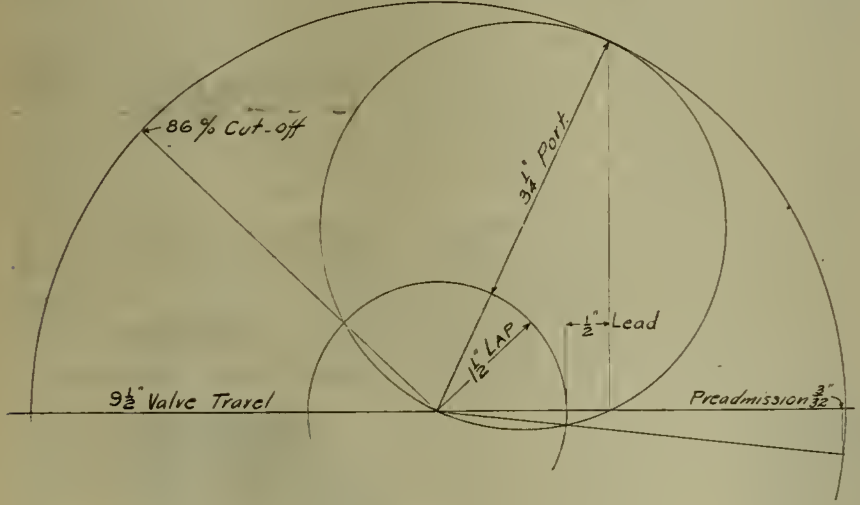


Figure 1.

Stephenson engine normally had 1 to 1⅛-in. lap and 5½ to 6 in. valve travel, this proportion being used to obtain from 80 to 87% cut-off in full gear. We still hold to these proportions very religiously in all new types of gear, though why we should do so has never been explained. Perhaps the explanation lies in the opening paragraphs of this article.

The object to be attained is the largest port opening practicable at the running cut-offs, and at the same time, the reduction of the preadmission in full gear to a negligible quantity in order not to interfere with the engine in starting. Some have sought to accomplish this end by increasing the diameter of the valve (piston), rather than increase the width of the port. It would appear as though increased size of valves and port opening must be resorted to, for while it is easy to get a restricted steam section on large power, we need never fear one too large. Our objective might also be obtained by the use of a double-ported piston valve, if one could be designed without introducing too many complications.

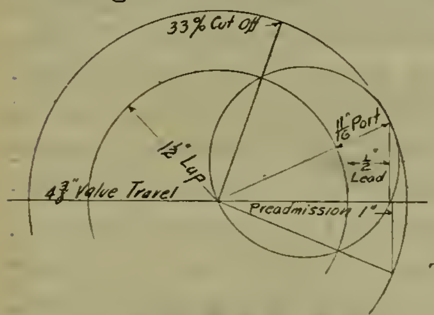


Figure 1-A.

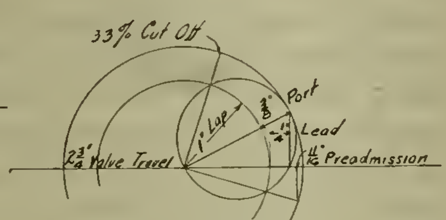


Figure 2-A.

In the absence of anything better, I have prepared a set of diagrams to show that the port opening at any desired cut-off may be vastly increased and yet restrict preadmission to such an extent that no bad effects will be experienced in starting. The same type of valve is used as at present, but I have taken the bull by the horns and changed the proportions throughout.

Fig. 1 illustrates a valve having 1½ in. lap, ½ in. lead, 9½ in. travel, and cutting off at 86%. Fig. 1A shows the same valve cutting off at 33%. Fig. 2 and 2A wil serve to illustrate a valve having proportions most generally used, irrespictive of the size of cylinder or service in which the engine is placed. Both valves are shown cutting off at like points for purposes of comparison. Assuming, then, that our engine is to operate generally at 33% cut-off, there can be no question but that a much higher efficiency will be attained and greater load hauled at a given speed by using valve as shown in Fig. 1A.

The port opening at 33% cut-off is 83½% greater,

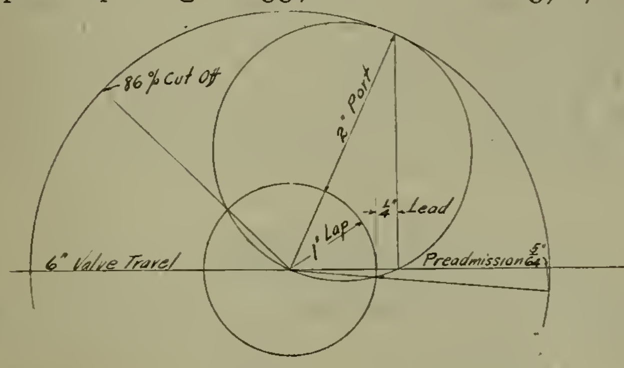


Figure 2.

while the preadmission in full gear remains practically the same in both cases. Preadmission at 33% cut-off is somewhat greater, but still within the limits of good practice. While a ⅜ in. port at this cut-off may be sufficient for 20 in. cylinders or under, it has been found inadequate for the larger ones. The whole subject of providing specific ratios of steam section through valves to cylinder diameter has never received the attention its importance deserves.

There may be some who object to the use of valves having too much travel, but I can only point out that the long travel occurs at low speed only; the travel at short cut-off can not be considered objectionable. Furthermore, valves having considerable lap are less apt to give faulty steam distribution than valves having short lap.

The advantage to be gained by a large port may be illustrated by indicator card shown in Fig. 3. The full lines indicate a good wide port at this cut-off, while the dotted line shows a restricted port, resulting in greatly reduced pressure on the piston and consequent loss in power, boiler pressure being the same. The shaded por-

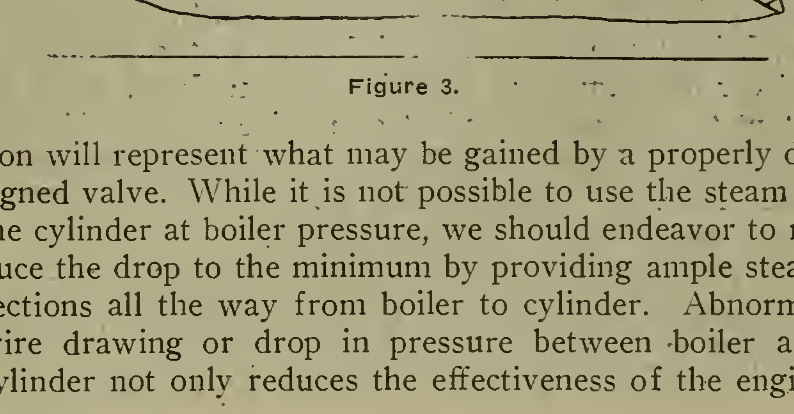


Figure 3.

tion will represent what may be gained by a properly designed valve. While it is not possible to use the steam in the cylinder at boiler pressure, we should endeavor to reduce the drop to the minimum by providing ample steam sections all the way from boiler to cylinder. Abnormal wire drawing or drop in pressure between boiler and cylinder not only reduces the effectiveness of the engine

in the tonnage which should be hauled at a given speed, but causes a waste of fuel and a poor performance in every way.

Valves should be designed according to the particular service expected of the engine and the cut-off (governed by speed) mostly to be used. The size of the port may then be determined with fair accuracy.

Hobbies or prejudices can not be indulged in here without detriment. We no longer figure the value of an engine and its economy by the monthly mileage, but by the tons it hauls. If an engine can not show a good record from this point of view, it is lacking, and the problem of those in charge is to determine how to overcome the difficulty, remembering it does not cost any more to man and house a good engine than a poor one.

PERSONALS

C. W. Van Buren has been appointed general master car builder of the Canadian Pacific Ry., with headquarters at Montreal, Que. He was born in Rensselaer County, N. Y., October 18, 1867, went to the common schools until 16 years of age and attended a night school for one year in New York City. In 1889 he began railway work as a carpenter at the West Albany shops of the New York Central & Hudson River R. R. In 1891 he was made foreman and two years later was put in charge of car department work on the Adirondack division at Herkimer, N. Y. In 1896 he was transferred to Utica in charge of car department work on the Adirondack and Mohawk divisions. He entered the service of the Canadian Pacific in July, 1905, as general inspector on the lines east of Port Arthur, and the following year was appointed division car foreman of the eastern division. In July, 1909, he was promoted to master car builder of the eastern lines, with headquarters at Montreal, and in May, 1911, went with the Union Stock Yard & Transit Company, Chicago, as assistant general superintendent. In January, 1915, he became general foreman of the Milwaukee Refrigerator Transit & Car Company at Milwaukee, Wisc., which position he held until his appointment as general master car builder mentioned above.

T. J. Burns has been appointed superintendent of rolling stock of the Michigan Central R. R. at Detroit, Mich., effective May 1. He was born July 24, 1869, at Hillsdale, Mich., graduated from Bay City (Mich.) high school, from Assumption College, Sandwich, Ont., and took a postgraduate course at Grand Seminaire, Montreal, Que. He entered railway service April 15, 1890, in the track department of the Michigan Central R. R., since which he has been, consecutively, 1891 to 1902, in the car and locomotive department; 1902 to 1905, chief clerk in the locomotive department at Jackson, Mich.; 1905 to 1909, chief clerk in the locomotive and car department at Detroit; 1909, to June, 1912, assistant to the superintendent of motive power. He was appointed assistant superintendent of motive power in June, 1912, at Detroit, which position he held till his recent appointment mentioned above.

Charles Brunswick, who has been appointed master mechanic of the New York & Pennsylvania Ry., at Canisteo, N. Y., was born in Cohocton, N. Y., July 10, 1877. He received his schooling in Hornell, N. Y., and August 10, 1892, commenced an apprenticeship in the Erie shops at Hornell. August 6, 1899, he took a position with the New York Central at Corning, N. Y., and left to go with the Lehigh Valley in 1903. He entered the service of the Pennsylvania in the shops at Olean, N. Y., in May, 1904, as erecting pit foreman. In October, 1906, he went with the Erie in the air brake department at Hornell, N. Y., and in March, 1906, resigned to enter business for himself. He went with the N. Y. & Pa. R. R. in March, 1909, as assistant master mechanic at Canisteo, from which position he was promoted to master mechanic.

M. R. McDaniel, who has been appointed master mechanic of the Central Indiana Ry., succeeding J. Cullinan, was born at Lebanon, Ind., September 17, 1882. He attended the common and high schools, then entered the service of this railway as timekeeper at Lebanon in the master mechanic's office, on June 1, 1899. He was transferred to Muncie as storekeeper when the shops were moved to that point, and held that position until September 1, 1901, when he entered the shop as a machinist's apprentice. After serving his time he continued in the service as a machinist until October 1, 1908, when he was promoted to the position of general foreman. He held this position until promoted to master mechanic, as noted above.

W. C. Sealy has been appointed master mechanic of the Grand Trunk Ry. at Toronto, succeeding J. Markey, deceased. He began work in the erecting shop of the Grand Trunk Ry. in 1901 at Stratford, Ont., after graduating from the high school at that place, the Grand Trunk having just inaugurated its apprenticeship educational system for developing and training apprentices. He worked at this place for 7½ years as an apprentice, charge hand and general foreman of the shop, and in 1909 was transferred to Toronto shop as general foreman. In 1913 he was promoted to the position of assistant master mechanic of the Ontario Lines, occupying that position until May 1, the date of his appointment mentioned above.

Thomas Windle, who has been appointed master mechanic of the Denver & Salt Lake R. R. at Tabernash, Colo., was born October 8, 1878, at Sedan, Kans., and was educated in the common and high schools of Springfield, Mo. He entered the service of the Kansas City, Pittsburg & Gulf R. R., now the Kansas City Southern, at Pittsburg, Kans., as machinist's apprentice. After serving his apprenticeship he worked for various railroads throughout the country as journeyman, mechanical roundhouse and erecting foreman, and returned to the same location in 1902 as roundhouse foreman. Subsequently he held the positions of roundhouse foreman, erecting foreman, machine shop foreman, general foreman and district foreman at East Kansas City, Kan., Mena, Ark., and Stilwell, Indian Territory. He was promoted to shop superintendent of the Pittsburg plant, which position he left in 1910 to accept one as assistant master mechanic of the Minneapolis & St. Louis at Marshalltown, Iowa. In 1912 he accepted a position as master mechanic of the International & Great Northern Ry. at Palestine, Texas, which position he held until his appointment as mentioned above.

L. Chapman, who has been appointed assistant master mechanic of the Chicago & North Western Ry. at Belle Plaine, Iowa, was born in Clinton, Iowa, June 17, 1879,

and was educated in the public schools of that place. He went to work at the machinist's trade when 17 years old in the C. & N. W. shops. He was given the night foremanship February 11, 1906, and after four years was given the day job. On July 10, 1911, he was sent to Norfolk, Neb., as general foreman, and from there transferred on December 11, 1913, to Chadron, Neb., as division foreman of the Black Hills division. From there he went to South Pekin, Ill., as assistant master mechanic of the Southern Illinois division on September 20th, 1914, occupying that position until May 1, the date of his appointment mentioned above.

H. E. Beal has been appointed master mechanic of the Fort Smith & Western R. R., with headquarters at Ft. Smith, Ark.

C. T. Ripley, assistant engineer of tests, has been appointed general mechanical inspector of the Atchison, Topeka & Santa Fe Ry., with office at Chicago.

C. E. Brooks has been appointed acting superintendent of motive power of the Grand Trunk Ry. at Transcona, Man., succeeding Joseph Billingham.

N. R. Ross has been appointed engineer of tests of the Great Northern Ry. at St. Paul, Minn., succeeding W. R. Wood.

J. P. Roquemore has been appointed mechanical engineer of the International & Great Northern Ry. at Palestine, Texas.

T. C. Baldwin, general foreman of the machine shop at Conneaut, has been promoted to master mechanic of the New York, Chicago & St. Louis R. R., with which road he has been employed since June, 1889. He succeeds H. A. Macbeth, promoted.

Lewis L. Collier has been appointed master mechanic of the Pacific & Idaho Northern Ry. at New Meadows, Idaho, taking effect May 1, 1915. Previous to this Mr. Collier was general foreman of the A. T. & S. F. Ry. at Emporia, Kans. He succeeds L. L. McCowan.

A. M. Joiner has been appointed master mechanic of the Hawkinsville & Western R. R. at Hawkinsville, Ga., succeeding E. H. Brantley.

H. A. Macbeth has been promoted from division master mechanic to superintendent of motive power of the New York, Chicago & St. Louis R. R. at Cleveland, Ohio, succeeding F. A. Miller.

W. R. Pennell has been appointed master mechanic of the Norfolk Southern Ry. at Raleigh, N. Car.

M. F. Smith has been promoted from general car and locomotive foreman to district master mechanic of the Chicago, Milwaukee & St. Paul Ry. at Dubuque, Iowa, succeeding E. Z. Hermansader.

J. O. Southworth has been appointed master mechanic of the Blytheville, Louisiana & Arkansas Southern R. R. at Blytheville, Ark., succeeding D. S. Kysor.

W. G. Carlton has been appointed superintendent of power of the Grand Central Terminal at New York.

A. H. Eagar has been appointed superintendent of shops of the Canadian Northern Ry. at Winnipeg, Man.

L. A. Hardin has been promoted from general foreman to assistant master mechanic of the Chicago & North Western Ry., with headquarters at So. Pekin, Ill., succeeding Lee Chapman, promoted, effective May 1.

T. C. Keene has been appointed traveling inspector of the car department of the Wabash R. R. at Decatur, Ill.

M. R. McDaniel.

Thomas Windle.

D. J. Madden.

E. F. Youngcourt has been appointed division shop accountant of the New York Central R. R. at Collinwood, Ohio.

I. T. Burney has been promoted from locomotive engineer to road foreman of engines of the Southern Ry. at Spencer, N. Car., succeeding H. J. Heilig.

O. C. Campbell has been appointed road foreman of engines of the Southern Ry. at Selma, Ala., effective May 15.

N. P. Cosgrave has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific Ry. at Goodland, Kans., succeeding J. L. Boyle, effective May 17.

J. L. Curry, road foreman of equipment, has been promoted to supervisor of locomotive operation of the Chicago, Rock Island & Pacific Ry. at El Reno, Okla.

D. J. Madden, supervisor of locomotive operation of the Erie R. R., has been transferred from Cleveland to Youngstown, Ohio.

F. A. Metler has been appointed road foreman of engines of the Southern Ry. at Washington, D. C.

F. P. Miller, general foreman of the locomotive department, has been promoted to the position of general car and locomotive foreman of the Chicago, Milwaukee & St. Paul Ry. at Marion, Iowa, succeeding G. F. Hennessey.

T. C. O'Brien has been promoted from general boiler inspector to general foreman of the Cincinnati, Hamilton & Dayton Ry. at Lima, Ohio, succeeding W. H. Keller.

W. J. Peters has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha Ry. at Worthington, Minn.

Henry Thurber has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha Ry. at Mankato, Minn.

H. G. Becker has been appointed general foreman of the Delaware & Hudson Co. at Colonie, N. Y., succeeding A. Masters. Mr. Becker was previously employed as general erecting foreman of the Sayre shops of the Lehigh Valley R. R.

E. J. Case has been appointed general foreman of the Cincinnati, Hamilton & Dayton Ry. at Ivorydale, Ohio.

W. J. Davis has been appointed general foreman of the Detroit, Toledo & Ironton Ry. at Delray, Mich., succeeding O. N. Ballard, effective March 17.

W. H. Eddy has been appointed general foreman of the motive power department of the Delaware, Lackawanna & Western R. R. at Syracuse, N. Y., succeeding George H. Eck, deceased.

C. A. Halleen has been appointed general foreman of the New York Central R. R. at Ashtabula, Ohio.

J. S. Jones has been appointed general foreman of the Chicago & North Western Ry. at Boone, Iowa, succeeding L. A. Hardin, effective May 1.

Joe Moffitt has been appointed general foreman of the Delaware & Hudson Co. at Oneonta, N. Y., succeeding J. Gethins.

H. M. Muchmore has been appointed general foreman of the Atchison, Topeka & Santa Fe Ry. at Clovis, N. Mex.

H. Phillips has been appointed car foreman of the Great Northern Ry. at Kalispell, Mont.

J. P. Welch has been promoted from roundhouse foreman to general foreman of the Minneapolis & St. Louis R. R. at Minneapolis, Minn.

R. M. Westbrook has been appointed general foreman of the Chicago & Eastern Illinois R. R. at West Frankfort, Ill., succeeding A. J. Eichenlaub.

C. A. Beebe has been appointed general car and locomotive foreman of the Chicago, Milwaukee & St. Paul Ry. at Sioux City, Iowa, succeeding M. F. Smith.

G. P. Hodges has been appointed general car and locomotive foreman of the Chicago, Milwaukee & St. Paul Ry. at Mason City, Iowa.

E. W. Cook has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha Ry. at Etacea, Wisc.

A. F. Flynn has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha Ry. at Sioux Falls, S. Dak.

G. Feetham has been appointed acting roundhouse foreman of the Intercolonial Ry. at Truro, N. S.

J. Edgar Fulp has been promoted from machine shop foreman to roundhouse foreman of the Minneapolis & St. Louis R. R. at Monmouth, Ill., succeeding W. E. Harminson.

J. B. Halladay has been appointed roundhouse foreman of the Minneapolis & St. Louis R. R. at Marshalltown, Iowa, succeeding J. P. Welsh.

H. J. Hurley, roundhouse foreman of the Minneapolis & St. Louis R. R., has been transferred from Ft. Dodge to Des Moines, Iowa, change effective May 21.

T. M. O'Connor has been appointed roundhouse foreman of the Minneapolis & St. Louis R. R. at Ft. Dodge, Iowa.

H. E. Carlson has been appointed car foreman of the Great Northern Ry. at Billings, Mont.

W. L. Delaney has been appointed car foreman of the Chicago, Milwaukee & St. Paul Ry. at Tacoma, Wash., succeeding W. P. James.

W. R. Franklin has been appointed foreman of the Norfolk & Western Ry. at Petersburg, Va.

E. Pearson has been promoted from tank foreman to car foreman of the Great Northern Ry. at Hillyard, Wash.

C. H. Zerbach has been appointed car foreman of the Great Northern Ry. at Butte, Mont. Previous to this he was car foreman of the Minneapolis, St. Paul & Sault Ste. Marie R. R. and joint car foreman of that road and the Canadian Pacific, and later car foreman with the latter road at Moose Jaw, Estevan and Weyburn. He entered the service of the Great Northern in the Fall of 1914.

LOCOMOTIVES EQUIPPED WITH SOUTHERN VALVE GEAR

The Southern locomotive valve motion has been applied to or is designed and under construction for the locomotives of 37 different railway lines. This motion was first tested out on the Southern railway on a 22x30 in. Consolidated locomotive for 18 months and made an excellent showing. A series of dynamometer car tests showed increased efficiency and fuel economy. This railway has adopted this motion as standard and is equipping old locomotives with it as they pass through the shops for general overhauling. The device is being placed on the market by the Southern Locomotive Valve Gear Company, of Knoxville, Tenn., organized one year ago, and 175 engines are now in service on which this appliance has been placed. There have been equipped a sufficient number of locomotives, to go into service soon, to bring this total up to 250.

A NEW HAMMER BOLT HEADING MACHINE

The aim of the design of the hammer bolt heading machine, shown in the illustration, was to effect the gripping, starting and stopping movements automatically, and to free the operator of this labor so that he can devote his entire attention and energy to feeding the machine. Not only are these movements accomplished mechanically and automatically, but the main shaft, heading slide and hammer slides of the machine run continuously like a rivet header—making operation continuous—so that the machine in a sense sets the pace for the operator. He is freed from all else but feeding and can easily meet and maintain a uniform pace throughout the working day, and it is found that with this decreased labor the output runs from 60 to 100% higher than commonly received from a plain, or hand-lever type of machine.

A big advantage is gained in having the main shaft, heading slide and hammer slides run continuously, in that this does away with a starting and stopping clutch on the main shaft, and thus eliminates the attendant troubles from wear and clutch repair. And elimination of this clutch also makes higher speeds possible in the machine—all tending to promote higher outputs. A feature of this design is the ability to set or time the machine to make any quality of bolt desired, from three to eight blows, in one cycle or operation; and with the machine thus set to deliver a predetermined number of blows, the quality and finish of the output is necessarily uniform. The length of time, also, that the grips are open for feeding can be regulated to suit the needs or ability of the operator, according to the length or type of bolt being made. These changes are effected through a simple gear and cam construction.

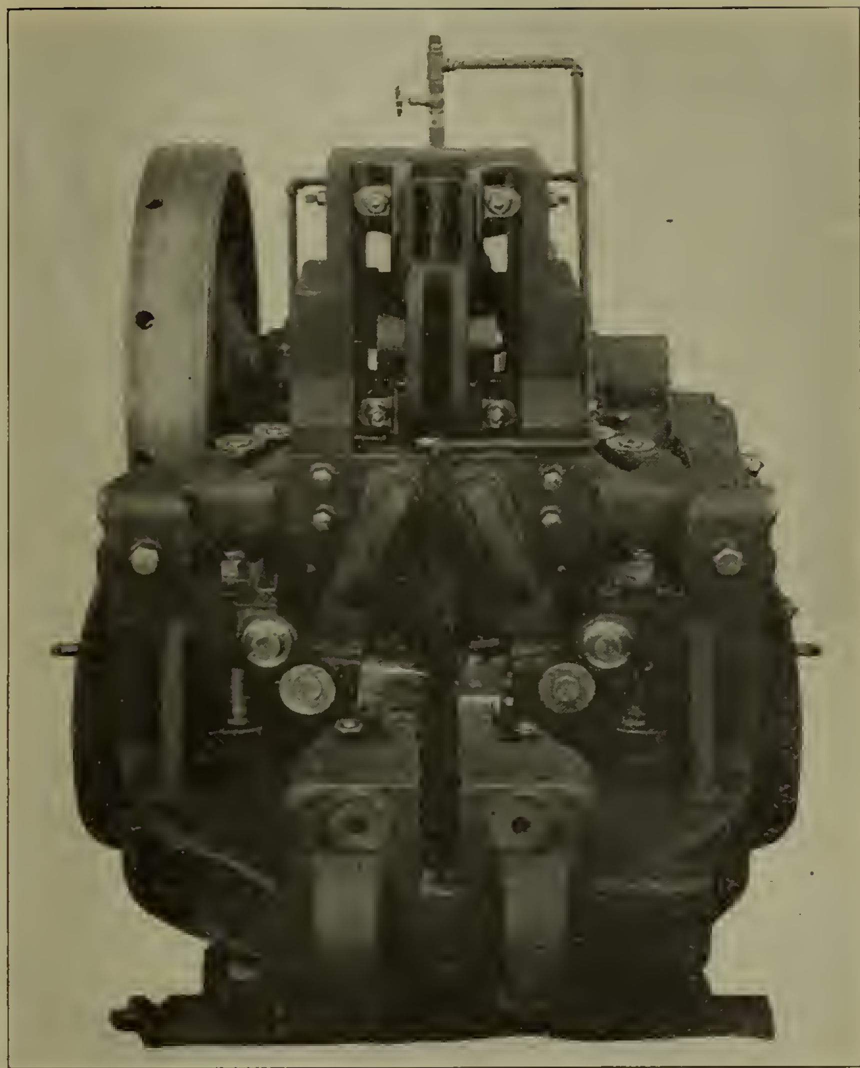
The bed of this machine is of the box type, of large proportions and heavily ribbed, inducing a high degree of stiffness and rigidity as well as strength, and the working parts and details are designed in accordance. This gives total freedom from all give or spring, which is detrimental either to the machine or output. The bolt being made by fewer blows and in less time, there is a better flow of the metal to fill out the corners. Also, with this greater strength and gripping power it is possible to work the metal at lower heats, and this ofttimes is productive of a better finish—there is less tendency for the metal to bulge either at the top of the bolt head or sides.

The speed of the machine is high, especially when compared with machines that approach it in weight and construction. The 1 in. machine runs at 140 r. p. m. at its maximum, and this, of course, could be materially increased if the machine were run on smaller work, as is

Etched Cross Section of Bolt Head.

the practice in the plain type hammer header. Other hammer headers of 1 in. rated size will be found to run from 95 to 120 r. p. m. when on maximum capacity.

The rigid construction, combined with the mechanically operated grip, makes it practical to introduce a cut-off attachment in the gripping dies, so that short bolts can be made directly off the rod. Short bolts ordinarily are hard to tong and to grip, and require cut-out dies that are expensive to make and maintain. With this shear or cut-off, short bolts are made with even more ease and facility than long ones. Four to six bolts can be made



View Showing Cut-off Attachment.

in one heat, depending somewhat, of course, upon the diameter and length of bolt made.

Another departure is the lever construction for carrying the lower hammer. In previous designs the lower hammer was carried in a slide, similar to the side and top hammers, and the scale dropping off the bolt as it was being forged got on to the slide, and this, with the action of the water, caused excessive wear, resulting in misalignment of the lower hammer. This lever construction eliminates this wear. The side and top hammer slides in this design are operated by bronze bushed links in place of cams and rolls. The cam construction has been eliminated because of its excessive wear, and the fact that it promotes spring and lost motion in the hammer slides.

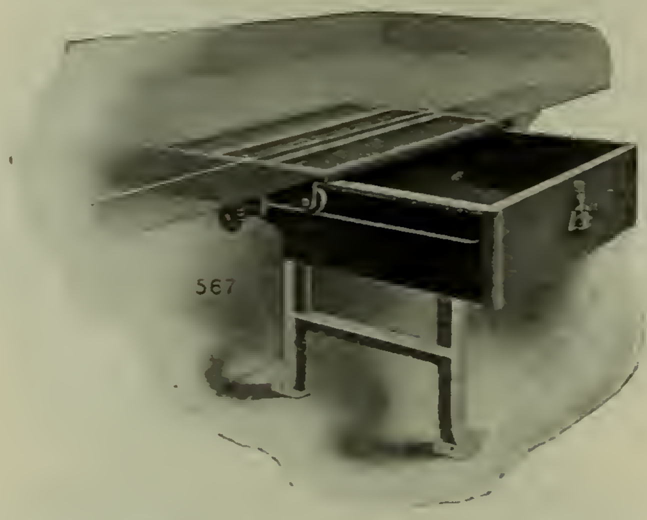
The flywheel of this machine is of friction-slip construction, which fills the role of an automatic safety device in case cold stock or an excess of metal is gripped in the dies and obstructs the travel of the heading tool. This flywheel also serves as a protection to the motor when the machine is direct motor driven. An automatic relief is also provided on the gripping mechanism to protect the machine against damage, should the operator accidentally get stock or some foreign object in the grips, other than in the holding grooves, which would prevent the dies from closing, and the machine from completing its cycle. This device is being made by the National Machinery Co., Tiffin, O.

The Fort Worth & Denver City has just ordered 1,200 40-ft., 40-ton steel center sill box cars, 300 40-ft., 40-ton steel center sill stock cars, and 200 100,000-lb. capcity, steel gondola coal cars from the Haskell & Barker Car Company.

BENCH LEGS

In a great many places shop furniture has not been given due consideration. This may perhaps be accounted for by the idea of most shop foremen that shop furniture should and can be economically built in the shop itself. This has been true to a large extent in the past, but when a manufacturer comes out and specializes on shop furniture, devoting his entire attention and skill to this one line of work, it is not improbable that some of his products will have advantages over the home-made variety.

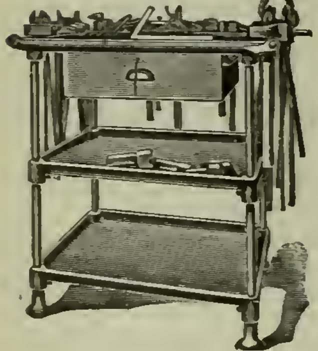
The New Britain Machine Co., of New Britain, Conn., has made a specialty of bench legs to such an extent that



Pressed Steel Bench Legs In Service.

its products are recognized as standard. To their older type of cast U-shape bench legs has recently been added a U-shaped pressed steel bench leg, of much the same design but lighter. These new pressed steel bench legs are described in a recent circular and much interesting information is given as to the economies that can be effected by their use.

In the end it costs more to get along without conveniences than with them. In no case is this more



Portable Bench.

Portable Trays.

clearly shown than in the use of portable work stands and tool stands, which save many steps as well as time and energy in reaching to the floor for tools, parts, etc. These portable, pressed-steel work stands have been designed in a variety of different forms and for a variety of purposes, and one can be selected which meets almost any requirements that can be set up in a railway shop at present.

The Chicago Elevated Railways have ordered 122 all-steel motor cars with Baldwin trucks from the Cincinnati Car Co.

NEW LITERATURE

The Homestead Valve Mfg. Co., of Pittsburgh, Pa., has recently issued a small folder starting with the fable or allegory of the toymaker who searches far from home to find the enchanted knife that at one stroke would carve whatever was in the mind of its owner. This circular goes on from this interesting point of departure to show that the Homestead quarter turn valve has overcome the difficulties that were found in the original plug valves.

The Watson Stillman Co., of New York, has recently issued its catalogue No. 92, giving 128 pages of hydraulic forcing and miscellaneous presses. This catalogue supersedes No. 70 and part of No. 82. The line of presses included are designed for such a variety of purposes that it is impossible in a short space to take up the classes of work for which they have been designed.

A machine for grinding reflex water glasses is described in a recent pamphlet of H. B. Underwood & Co., Philadelphia. The machine is simple in construction, has very few wearing parts, and these are protected from coming in contact with the grinding material, so that unnecessary wear is avoided. By means of an eccentric pin, an air motor imparts an oscillating motion to a revolving table, and the glass is prevented from being cut in concentric grooves. The glasses are held under flexible pressure, and provision is made to keep the grinding compound in contact with the glass.

* * *

A recent pamphlet of the Smooth-On Manufacturing Company, Jersey City, N. J., describes Smooth-On iron cement No. 7 for waterproofing brick and concrete. This cement is used in connection with Portland cement. A number of illustrations are shown.

* * *

Bulletin No. 34-U of the Chicago Pneumatic Tool Company, issued this month, gives detailed information for installing and operating the Chicago Pneumatic Class N-SO fuel oil driven compressors. This bulletin goes into detail regarding the foundation and placing of the compressor, setting it up, starting, adjusting, cleaning, and repair parts.

PERSONAL

George C. Wilson, of the Independent Pneumatic Tool Company, Chicago, Illinois, has been appointed manager of that company's Atlanta, Ga., branch, succeeding F. H. Charbono, who has been transferred to Boston.

The Albany Southern has one double truck snow plow for sale.

The Chicago Great Western R. R. is said to be contemplating the purchase of locomotives. Bids are asked on 5 switching (0-6-0) locomotives and 5 Mikado (2-8-2) locomotives.

The Florida, Alabama & Gulf offers locomotives for sale.

The Fort Worth & Denver City has recently placed an order for 10 oil-burning, Mikado type locomotives with superheaters, with the Baldwin Locomotive Works.

The Gould Southwestern offers 2 locomotives for sale and is in the market for one locomotive.

The Iowa & Illinois will sell one locomotive.

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CONTENTS.

Mechanical Conventions

To make an attempt to report all that was done in the Convention Hall at Atlantic City at the annual meeting of the mechanical associations would be unwise, if not impossible. The work of many committee men is brought each year to the conventions to be discussed, and to be approved or rejected. The volumes published each year by the associations themselves is a clear index as to the character, the value, and the amount of the work that is done. So vast has been the quantity of information that has been accumulated each year that it is hardly within the province of a railway journal to attempt to republish the papers or the discussions. Taken as a whole, they become a matter of reference value, rather than technical news and information. It is, however, entirely fitting that a publication like the *Railway Master Mechanic* should comment on that which has been done; criticise if it seems wise; approve if it seems best; or make any suggestions that may be of benefit,—in a word, comment on what has been done, rather than to report in detail the convention proceedings. That which we have to say in regard to the recent conventions, it is hoped will be indicative of what was done there.

In commenting on the conventions, we shall refer to three distinct organizations,—the American Railway Master Mechanics' Association, the Master Car Builders' Association, and the Railway Supply Manufacturers' Association.

American Railway Master Mechanics' Association

The American Railway Master Mechanics' Association held its forty-eighth annual convention at Atlantic City, N. J., June 9th, 10th, and 11th, 1915, the opening session being called to order the first morning at 9:45 by President F. F. Gaines, superintendent of motive power of the Central of Georgia R. R. The address of the president of the association had both a retrospective and suggestive value, and a brief reference to Mr. Gaines' address will be in place before taking up the papers and the discussions.

At the beginning of his paper, the president referred to the fact that he did not recall any radical change in locomotive design, but that there had been developments along other lines which he wanted to call to the consideration of the members. It is interesting to note that his first suggestion refers to the consolidating of the two mechanical associations into one association. There have been many arguments pro and con on this subject. The joining of the two associations, amalgamating them into one, was suggested nearly fifteen years ago in an editorial in the *Railway Master Mechanic*. Undoubtedly this would be the reasonable thing to do, as we suggested at that time, as it would undoubtedly work to greater efficiency. What we should have, however, is not so

much a consolidation of these two associations as the bringing together, under some working arrangement, of all associations of the mechanical department at one annual convention. This, however, will be referred to more at length further on in this editorial comment, coming under the heading of the Railway Supply Manufacturers' Association.

The extension of standards and specifications was urged, and, for enlarging the influence of the association in the standards which they have already adopted, it would seem wise that the co-operation and endorsement of the American Railway Association be sought. Suggestions were made with the idea of enhancing the value of the proceedings of the association. An exceedingly good point was made in the suggestion that the committee reports be submitted earlier, so that there might be time after their distribution to give members a better opportunity to carefully study and examine them. Mention was made of the University of Illinois and its locomotive testing facilities. The possibility of making use of this testing plant as an association matter, rather than leaving it to the individual roads, was referred to, the idea being that there would be a saving in expense and a wider distribution of knowledge by so doing. The address in general was very characteristic of Mr. F. F. Gaines in that it was not only thorough and far-reaching in its suggestiveness, but it was brief and pertinent to important subjects now before the railroads.

The reports of the secretary and treasurer showed the membership of the association to be in excellent shape,—900 active and 161 representative, associate, and honorary members, making a total of 1,061. The gross amount of financial transactions for the year amounted to $10,757.24, and the treasurer reported on hand at the close of this year's business $1,213.28. The dues of the active members were fixed for the year at $5.00, and for representative members on the basis of $7.00 per 100 locomotives owned by the railroad represented.

The subjects discussed in the papers presented are briefly referred to in another section of this issue, and speak for themselves in showing the live, wideawake, and energetic work of the Master Mechanics' Association. Forty-eight years of progress on the part of this association have left their indelible imprint upon American railway progress. This publication extends to this organization its congratulations for past work accomplished, and good wishes for its future.

Master Car Builders' Association

The Master Car Builders' Association held its forty-ninth convention at Atlantic City June 14th, 15th, and 16th, 1915. The address of President D. F. Crawford, of the Pennsylvania Lines, West, was characteristic of the man, and indicative of the splendid work which this association has done. It is to be regretted that space does not permit of our giving this address in full. Mr. Crawford referred in the first part of his address to the fact that "the problems involved in the construction, operation, maintenance, interchange, and accounting for the use and repairs of cars seem each year to become more complicated."

"Notwithstanding the excellent, yes almost wonderful work accomplished by the Master Car Builders' Association, there remains much to be done, and much that can only be accomplished by more closely co-ordinating the work and rules of the several associations having to deal with different phases of car construction and operation, and we should seek to establish closer relations with the American Railway Association, the Association of Transportation & Car Accounting Officers and American Railway Accounting Officers' Associations not only for the purpose of better understanding of the requirements of these bodies, but to avoid duplication of investigations and conflict of rules or regulations. Concerted effort must be made to obtain the largest practicable mileage per car per year, with proper regard for the safety of operation, and to eliminate as rapidly as may seem proper any rules which unnecessarily hinder the prompt movement and interchange of cars. Any method which would expedite, with efficient safeguards, the movement of freight cars, would be welcomed by those responsible for the financial results of railway operation, as well as by the operating officers. To inaugurate and give impetus to consideration of this subject it might be suggested that this association express formally to those kindred bodies, and all others interested, our desire to confer with them."

Referring to the increasing complexity of the construction, maintenance, and interchange of cars, Mr. Crawford asked for a closer observance on the part of the members of the Master Car Builders' Association of the proceedings of their associations in railroad service,—something in the way of co-operation, which would give to the railroads generally the benefit of the work of all the associations, at the same time bringing more prominently before every one the authoritative work of the Master Car Builders' Association.

Brief reference was made to the safety appliance acts, and the necessity for giving careful consideration to the establishment of added supervision and inspection, in order to comply with the United States national laws. For the future work of the association, Mr. Crawford presented three items as being of the greatest importance:

1st. Standardization of equipment. Much indeed has been accomplished, but up to the present time attention has been largely devoted to dimensions and details. Of course, each detail decided upon gives promise of ultimately reaching a conclusion on the larger problem, but is not now the time for this association to agree on

standard freight car trucks, standard box, stock, refrigerator, hopper, gondola, and flat cars? We all remember the letter written by Mr. Ripley, president of the A., T. & S. F. Ry., on this subject, which was read at the convention last year. Can we not by concerted efforts adopt standards which will make unnecessary such stimulation?

2nd. Simplification of the rules of interchange. One has but to read in the report of the arbitration committee the suggestions they receive as to changes in the rules, to fully realize how much has already been accomplished in this direction, but I trust they will harden their hearts and make even less changes than they have in the past. The members can assist them very much indeed by confining their recommendations for changes to those items only which are frequently involved.

3rd. Co-operation with the American Railway Association in expediting the movement of cars. This subject has already been presented to you.

If President Crawford's speech was indicative of anything, it was of an increasing number of problems to be solved, and an ever-widening field of activity for the Master Car Builders' Association. Judging by the work which the master car builders have done in the past, there seems to be no question but that their work in the future shall be of infinite value to the railway service.

The reports of the secretary and treasurer showed the membership of the association as 963; the number of cars represented was given as 2,809,562. The total of the financial transactions during the year was $32,800.50, and the balance in the treasury was $627.91. Dues for the active members were fixed at $5.00, and for representative members at $7.00 per year.

Railway Supply Manufacturers' Association

This association is only a by-product of the American Railway Master Mechanics' Association and Master Car Builders' Association. By-products, however, very often come to be of very great value. Unquestionably this is the case in the present instance.

An annual exposition of railway supplies and equipment is held each year in connection with the mechanical conventions. The membership of this association includes men whose life work has been the solving of the problems of railway service. Upon them have rested the problems of better locomotive design, better material, better equipment, better specialties for the locomotive, better machines for the shop in which the locomotive is repaired, etc. Upon them has rested the responsibility for solving the problems of car roofs, underframes, truck side frames, draft gear, air brake, brake beams, etc. Just a moment's reflection emphasizes the fact that this "by-product" has been of inestimable worth in the advancement and perfection of railroad locomotives, cars, shops, machinery, various equipment and supplies. What has been done by this association is not a matter of record on a printed page, but is ever a matter of increasing interest as found in the annual exhibition which is held.

Reference was made in the first part of our comment to the desirability of having all railroad associations in the locomotive and car department meet at the same time. The big reason for doing this lies in the exhibition furnished each year by the Railway Supply Manufacturers' Association. These exhibits are of tremendous educational value to the railway official, and more so to the lesser railway official, and the employe. An annual meeting place, centrally located, where every railway man who could be spared from service could come to see and note the progress made by railway supply manufacturers, would be of tremendous educational value to the employes of the railroads. This education would reflect itself during each ensuing year in the bettering of service; in the lessening of expense; and in the faster and surer advancement in the art of transportation. While railway supply manufacturers in large part are furnishing printed matter that is of educational value to the railroad employes, it is impossible to give the many such comprehensive idea of what they are manufacturing by showing it through printed matter, as can be done by showing the specialties and equipment themselves.

There is also another phase of the situation, and that is that at the present time the burden of expense upon the supply manufacturers is very large in their attempt to exhibit that which they manufacture at all of the meetings of the various organizations of the mechanical department. Some arrangement whereby it would be possible for the railway supply manufacturers to exhibit once each year, instead of a dozen or more times, would eliminate a large economic waste, which, in the final analysis, must be borne by the railroads themselves. In these days of most rigid economy, it must be remembered that an expense to the railway supply manufacturer is in the long run an expense to the railroads.

Mechanical Conventions

When all is said and done, the work accomplished by the three associations which have met each year in June for many years past has been tremendous. To no associations do the railroads owe any more,—and through the railroads the public,—than to the three associations mentioned. Their work has been more wide and far-reaching than can ever be estimated.

Marking Time

"Marking time" was an expression used by one of the leading railway officials in an informal discussion on one of the porches at Atlantic City at the recent conventions

of the Master Mechanics' and Master Car Builders' Associations.

"Marking time" seems to be pretty fairly descriptive of conditions as they now exist with most railroads. The average official is so busily engaged in trying to keep down operating expenses that he hardly has time to do more than "mark time"—no chance to advance personally, no chance to advance in behalf of his railroad, and still less chance to help the advancement of the railway service generally.

New appointments in railway service, or promotions, are very few. This seems to be true of most of the railroad companies. At such times as these, when it is a hard matter to make both ends meet, there is very little change in personnel for the reason that the railroads cannot afford to increase their supervision, although it may appear to them to be a good thing to do.

The situation was summed up in a conversation with a railroad president recently, when he said, "The railroads are really too poor to be economical." Possibly the old expression, "A man does not swap horses when crossing a stream," applies somewhat in these days when we are "marking time." The railroads are going through a stream of adversity, and the men who bear the brunt of railroading are carrying the railroads through. The railroad managements realize the situation and are very loath to make many changes. They don't care to "swap horses."

There is, too, the wonderful loyalty on the part of the men working for the railroads, trying to help them through this period of storm and stress. Of course, it may be in this connection that men holding positions on railroads are not so frequently induced to leave to accept better positions because business generally does not demand such changes.

There is no question of the facts. We are "marking time," and in all this great country there is no class of men more ready or eager to march forward, make progress, and do those things which shall be for the greatest good to the greatest number in the upbuilding of the property of this country than the railroad man.

LETTERS TO THE EDITOR

Editor, *Railway Master Mechanic:*

A question that in my opinion is of much importance is that of brake beam hangers and fastenings. There is a great deal of trouble experienced all over the country on account of these failures, which frequently result in derailments and serious accidents. I have been investigating to find the cause of these failures, and from the information at hand am convinced that it cannot be placed at any one point, but that the whole arrangement is not sufficiently strong to perform the work for which it was originally intended. I find that a great many brake heads fail; hangers, pins, also the various fastenings, and in many cases the brake beams themselves, will fail, particularly the truss rods. In many instances beams of this type will meet the M. C. B. tests when new, but it seems after being placed in service the rod will fail just back of the nut. It is my opinion that the whole arrangement should be changed and that one of much greater strength should be applied, which would permit of wear and vibration for several years to come. I have in mind something similar to the arrangement on passenger cars, which is giving practically no trouble.

We expect to adopt a design on all of our freight cars, which is similar to the passenger car arrangement and will, in my opinion, overcome at least 75 per cent of the present trouble. Many car and mechanical men would undoubtedly claim that this hanger was unnecessarily strong and it might be so, when figured from a theoretical standpoint, but in arranging a design of this nature I believe a few pounds of metal will add so materially to the strength that the extra few cents in cost would not be an item to consider at all. With the new arrangement I feel confident that the safety chain arrangement, which is only half perpetuated throughout the country, can be dispensed with altogether.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION

The eleventh annual convention of the International Railway General Foremen's Association will be held at the Sherman Hotel, Chicago, Ill., July 13, 14, 15, 16, 1915. The topics for 1915 cover a wide range, and are suggestive and timely.

"Valves and Valve Gearing" will be handled by Chairman Walter Smith, of the C. & N. W. Ry., and those who have followed Mr. Smith's recommendations along the lines of roundhouse efficiency as read and discussed from his 1913 and 1914 papers on that live subject, may rest assured that no detail will be missed in this interesting subject.

Another interesting topic will be presented by Mr. A. A. Maste, of the D. & H. Ry., on "Rods, Tires, Wheels, Axles and Crank Pins." This subject will be of particular interest to the foremen attending the convention.

"Shop Efficiency," by Chairman Geo. H. Logan, of the C. & N. W. Ry., will be a spot-light topic. Railroads are looking after the pennies in these days of efficiency and economy, and it is up to the shop foremen to show why their cost of repairs is not as low as is their competitors. Mr. Logan will tell you how.

Mr. N. B. Whitsel, of the C. & W. I. Ry., will tell the members everything worth knowing about operating a big roundhouse terminal, and as Mr. Whitsel general foremanizes one of the largest in the country, his paper will be worth going some distance to hear. Mr. F. A. Byers, of the Frisco Lines, is chairman of one of the most wideawake topics ever handled; a subject that treats on the mechanical saving of many thousands of railroad company dollars by using oxy-acetylene welding processes. Mr. Byers is a past master in welding under this method, and handles the subject without gloves.

The convention of 1914 was the largest in point of attendance that the association ever held, and judging from reports from all sources the present meeting will eclipse all others in point of attendance.

General, shop and roundhouse foremen are requested

to attend and take part in the discussions. Railway companies which are out to make a financial showing in their operation can not afford to be without representation.

BOOK REVIEWS

GRAPHIC METHODS FOR PRESENTING FACTS. By Willard C. Brinton. Three hundred and seventy-one 7 x 10 inch pages; 256 illustrations; indexed; cloth bound. Price $4.00. The Statistics Bureau, 5 East 42d St., New York City.

This book deals with the graphic presentation of facts, figures and deductions. While it is true that figures cannot lie, they are often gotten together in such form as to be very deceiving. When figures are put in graphic form there is much less danger of misinterpretation. The graphical method of presenting data has grown rapidly in recent years, especially in the engineering profession. Accurate data and real facts are valuable, but they lose their effectiveness by not being properly presented. The author shows just how all sorts of charts and curves should be used, so as to be most effective and convenient. The book is profusely illustrated, the illustrations having been selected partly on account of the educational value of the facts, but chiefly because of the methods used in presentation. We do not know of any other book that covers this field in so thorough a manner. The diagrams, charts, maps, etc., are arranged so as to present systematically the subjects covered. The work as a whole is very interesting and will undoubtedly be of valuable assistance to executives, engineers, draftsmen and other men to whom the graphic presentation of facts appeals.

A STUDY OF BOILER LOSSES, by A. P. Kratz, has been issued as Bulletin No. 78 of the Engineering Experiment Station of the University of Illinois, gratis on request.

This bulletin presents a critical analysis of the data taken from a series of twenty-five trials made on a 500 horsepower Babcock and Wilcox boiler in the university heating plant.

The heat balance has been subdivided so as to isolate and determine the amounts of the several losses chargeable to the boiler, furnace and setting. Complete forms for calculating a series of boiler trials are also given.

Tests were made also upon some samples of weathered coal. No difficulty was experienced in burning this coal, but it was found that it had deteriorated during the weathering until it was about the same composition and grade as fresh Vermilion County screenings.

UNIFORMITY OF CAR INSPECTION--

BY M. MAREA,

General Superintendent of the St. L. T. & E. Ry.

I was assigned for discussion the subject of uniformity of car inspection as well as uniformity of transfer and responsibility and will take up the question in 3 sections: (1) Interchange points, (2) delays to cars, (3) need for greater co-operation between car departments throughout the country.

The inspection of cars at interchange points interests the members of this Association more than any other. It is the problem which confronts inspectors and car foremen to-day and which requires men of more than ordinary ability to solve. A good car inspector is one of the most valuable assets that a car foreman can have and a car foreman is the most valuable asset that any railroad can have, if he is capable of passing judgment on the cars that are to run upon his rails. The latter question may not seem important, but it is of vital importance from an operating standpoint.

Not only is the inspector responsible for the condition of the cars but he makes his company responsible to the consignee or consignor for the delay of the freight that is contained in the car which has been shopped. This reverts back to the traffic department, which has spent many hours and probably days of hard work to secure the shipment of this particular commodity over its rails. Consequently the inspector must be a man of more than ordinary intelligence and must use good judgment and not hold a car for repairs that can safely go forward. I have found that the source of the greatest trouble between car inspectors and car foremen is trying to "get even with the other fellow." This is decidedly wrong. You must be fair and honest with your own company, also with your delivering line, and not shop for repairs any car which in your judgment can go forward.

Of course some mistakes will be made. Certainly there is no car inspector who would let very many cars go forward and make a mistake in doing so.

Too many cars are being delayed by inspectors because certain visible defects exist which apparently justifies them in sending the cars to the transfer track. This is frequently because the car department has been allowed only a certain amount of money and the foreman in charge feels that he has not money enough to make the repairs; the car is therefore marked for the transfer track and a claim made for defects. If the claim is cut by the chief interchange inspector, the contents are nevertheless transferred and the car returned to the delivering line. The delivering line in 99 cases out of 100 loads the car without repairs being made and it sails forth in a different direction and carries its contents through interchange points safe and sound without complaints being received from 3 or 4 of the interchange points which it passes through.

Now if the car department is charged back with the cost of the transfer, the per diem of the load and empty as well as the damage to the contents, the transfers of to-day would, I dare say, decrease 75% because of placing the responsibility where it actually belongs.

You may wonder why I make such a broad assertion, but the car department is wholly responsible to the operating and traffic departments for the furnishing of equipment that is in safe and serviceable condition to handle whatever commodity it is desired to place therein; and if the car gets in bad order through unfair usage the car department is not responsible. It is, however, wholly responsible and should be charged up with the transfer charges as well as the damage to the contents.

The car departments throughout the country are not working close enough together and are not using what may be called a broad and liberal interpretation of the Master Car Builders' Rules for interchange of cars.

* A paper read before the April meeting of the Car Foremen's Association of St. Louis.

Railway Master Mechanics' Ass'n

A Brief Discussion of the More Important Papers Given Before the 48th Annual Convention

Brief reference has been made in the foregoing pages to the annual meeting of the American Railway Master Mechanics' Association, the president's address, and some of the business preliminary to the presentation of the papers and the discussion which followed. Therefore, in the following pages will be found only a digest and a brief reference to some of the more important subjects presented and discussed.

Report of Committee on Locomotive Stokers

The report of the committee on locomotive stokers, being the first read before the convention, shows that, in the opinion of this committee, the locomotive stoker has reached the point of dependability. In other words, it is no longer an experiment. The committee's report in part is as follows:

Another year's experience with the locomotive stoker strengthens the conviction that it is not only accomplishing its purpose, but withstands the test of continuous service with remarkable durability. In previous reports your committee has endeavored to cover a brief description of the principles upon which stoker manufacturers and inventors seem to be working, and at the same time group the machines with respect to their dominant features, giving a limited explanation of their operation, characteristics, and to an extent their value, using certain grades of fuel and conditions of operation.

Assuming quite sufficient has been said in magazine articles and individual papers, it was the desire of your committee to present data to show the efficiency of the stoker using some of the different grades of fuel and under varying conditions of operation, as might be secured from a test plant, but to their regret this has not been possible. However, some observations have been made and some interesting data compiled from their performance in road service.

While it may be said that nothing novel has been presented during the past year, a great deal of very good work has been done along already established lines. The effort has been chiefly in the refinement of detail parts; redesigning and improving them to better withstand the service. In some cases manufacturers have added new parts; in others, parts more durable have been substituted; again, parts have been entirely eliminated. But watching the progress from the outside, one may be impressed with the thought that on the one hand there is that fear of added complication, while on the other the fear that vital features may be disturbed. Still, simplicity is always desirable without the sacrifice of utility, each design is a study in itself, and efficient development can only be made by degrees.

There is no such thought that the stoker is unlike other mechanical devices on the ground that it is not susceptible to failure; and when it gives way it will usually do so under service strains. On the contrary, to meet such a contingency, designs are being studied with the view of fixing the point of failure where repairs can be conveniently made, preferably without a road delay, and when it so happens that repairs can not be made on the road, the emergency can be met by resorting to hand firing until terminal is reached. The theory that the parts of the stoker be amply strong and in excess of the strength of the engine has its advantages.

In the consideration of designs, attention is being given the matter of accessibility of parts, as well as certain features of the locomotive that are now, in some cases, difficult to reach on account of the stoker. The stoker manufacturers have advanced considerably in their attempt to apply machines to existing locomotives, and it is safe to say their work has been somewhat hampered. At the same time, it is reasonable to suppose that if the designs were considered along with those of the locomotive, and both are given equal consideration, more latitude would be offered than is now possible on account of the limited space and the absence of choice in working out certain essential features.

Any of the stokers now in extensive use will, it seems, occasionally become inoperative by clogging. At times it is due to wet coal, then again to lump coal. However, most of the clogging, especially that of a serious nature, is caused by junk and foreign matter, such as spikes, chains, pieces of iron, etc., finding its way to the stoker machinery. Viewing the prevention of such foreign matter reaching the vital parts of the stoker as probably impracticable, the use of a reversible engine has been advocated, and, in fact, is receiving attention, hoping by virtue of its reverse motion to permit the withdrawal of an obstruction without breakage of parts or very much delay. Its value generally, of course, is yet to be conclusively demonstrated.

Time and experience have brought progress in the way of improving the manipulation of the scatter-type stokers, both in the care of the machine, as well as in a more efficient use of fuel. In the earlier days of the stoker, when the aim was mainly centered upon its continuous and satisfactory operation and ability to cover the division without failure, firemen in many instances habitually shook the grates almost every time the engine stopped, regardless of the condition of the fire. As a result a much thinner bed of fire was carried than economy required. The pop valves were up most of the time. In-

Booth of Joseph Dixon Crucible Co.

Wm. Anderson, Pantasote Co.; Wm. A. Lake, Pantasote Co.; J. J. Ewing, Mech. Engr., Chesapeake & Ohio

John M. High, Pantasote Co.; D. W. Pye, Transportation Utilities Co.; H. U. Morton, Acme Supply Co.

J. A. Dildine, Chief Clerk Motive Power Dept., Pennsylvania Lines West; H. M. Wey, U. S. Metallic Packing Co.

P. C. Staley, Gen. Fore., Pennsylvania; H. F. Lowther, Asst. Pur. Agt., D. L. & W.

J. M. Griffin, Wheel Truing Brake Shoe Co.; R. E. Dupell, Road Fore. of Engines, West Jersey & Sea Shore

structions and experience have effected marked improvement, and now it is rather rare to find a fireman disturbing the grates so long as a sufficient steam pressure is maintained to handle the train efficiently and successfully. The stoker is started, stopped and otherwise controlled with better regulation of fire and less loss of steam through the relief valve. Experience shows that the grates should not be disturbed as long as the fire is maintained in good condition, and the required air is permitted to pass through the grates to supply the proper rate of combustion. Frequently, when it is found necessary to shake the grates, the fire is level to the fire door; at other times it is very light. The maximum depth of the fire should vary with the physical character of the coal, and to a degree with the chemical constituents in the ash. Your committee is of the opinion that where the fireman will use his judgment the operation can be successfully manipulated with less physical exertion, and this precaution will result in reducing loss of fuel through the grates and relief valves, as well as reducing the physical effort on his part.

STREET STOKER—OVERFEED OR SCATTER TYPE

The Street stoker (one of the first, if not the first, to demonstrate its capacity to deliver fuel at a rate in sufficient quantity and regulation to maintain satisfactory steam pressure) still shows the largest number in service, totaling 531, with twenty-four on order, as shown in statement. The type "C" stoker, which is the latest design, has a variable-speed engine and a friction clutch, instead of differential gear that was employed in the earlier type machines. The type "A" machine carried a crusher on the tank, but in the latter designs the crusher was set aside, the conviction being it was better under certain conditions to supply the fuel that would pass through the 2½-in. mesh on the locomotive tender. These stokers are in operation on fifteen railroads. However, from the tabulation showing the distribution of the stokers, it can be seen that most of them are found on eastern roads, the B. & O., N. & W. and C. & O. having eighty per cent of the total number in operation. The Street stokers are operated in passenger, general fast and slow freight service, performing their work satisfactorily. The machines have done remarkable work, on account of their durability, and nothing more is needed in their favor than their record and applications made. The principle upon which the machine is designed and operates is very widely known.

CONCLUSIONS

In conclusion it seems safe to say that the mechanical stoker has demonstrated by extensive service that it is capable of supplying coal to a locomotive fire box at a rate and under sufficient control to satisfactorily maintain the working steam pressure. It is also obvious, being a machine and working continuously, it should be capable of maintaining a more regular rate of steaming with certain grades of fuel than might be obtained in average hand-firing practice. The average steam pressure for a division run seems to be in favor of the stoker on account of the higher average pressure maintained, especially toward the end of the run. It might be said, therefore, that greater work is done with the stoker, in terms of speed or tonnage, or both, under certain physical and operating conditions, while in another service with equally large engines and heavy tonnage, but under more favorable grade line and fuel conditions, as high efficiency has been obtained hand-firing. It is also evident that the capacity of the stoker, since it is a mechanical device, is only limited by its allowable dimensions, and its endurance should be that of machinery dependent upon design and attention.

Report of Committee on Boiler Washing

This committee reported very elaborately as to the questions asked in the canvass made of the membership of the association, summarizing the following boiler washing practice of the railroads:

"As for mileage made between washouts, 9,760 engines make less than 500 miles; 11,283 engines make over 500 and less than 1,000 miles; 20,472 engines make over 1,500 miles, with 2,467 not replying or unable to furnish information. The passenger locomotives make 30 per cent greater mileage between washouts than freight engines. Only about 5 per cent of the roads in the country practice changing water by systematically blowing boilers at terminals. About 35 per cent of the engines are blown out regularly and systematically while on the road, to remove mud or sludge that may have accumulated in the boiler, and to prevent foaming. The maximum number of washout plugs reported in a boiler was 52, with a minimum of 10, or an average on all modern power of 32. There is a wide variation as to cost, some roads reporting as low as 10 cents, others as high as $5.50. It is evident to the committee that this question was not thoroughly understood, as some roads reported the cost of water only. From the information gathered from the reports, it appears to cost about 35 per cent less to wash with hot water than it does with cold water. The average boiler washing pressure at the pump or line was 96 lbs., and about 72 lbs. at the nozzle.

"Hot water systems were reported as being used on 54 roads, 13 being the maximum number reported on any one road. Some roads only reported using same at one or two roundhouses. Some report using the injector to heat washing and filling water. The use of hot water for boiling washing plants shows an average reduction in the amount of water used of 3,427 gallons, or 36 per cent, some roads reporting as much as 9,000 gallons. A reduction in time of one hour and 54 minutes, or 42 per cent, seems to result from the use of hot as compared with cold water for washing, while at the same time there is a saving in fuel of 897 pounds, or 36 per cent. In

Walter B. Leach; Hunt Spiller Mfg. Co.

F. O. Brazier, Murphy Varnish Co.; J. M. Borrowdale, Supt. Car Dept., Illinois Central

S. W. Midgley, Acme Supply Co.; Bruce V. Crandall

M. W. Halbert, C. I. I., American Association Railroad Superintendents; J. E. Tarelton, Union Draft Gear Co.

A. B. Wegener, Camel Co.; J. W. Senger, M. C. B., New York Central

Bruce V. Crandall; W. G. Krauser, Union Draft Gear Co.; Harry L. May, S. M. P., C. I. & L.; J. R. Cardwell and J. E. Tarelton, Union Draft Gear Co.

addition to this all roads except one report a great reduction in boiler troubles, especially as to cracked sheets, leaky stays, etc., from the use of hot water, or an average reduction in these troubles of 34 per cent.

"As for water-treating, 31 roads report using water-softening plants at wayside tanks, 45 roads report using chemicals in engine tenders, 19 using soda ash and 26 boiler compound, 76 roads report using boiler compound, soda ash and other chemicals, to prevent incrustation, and 29 roads report using boiler compound or other chemicals to prevent foaming. Very few roads specifically treat water to prevent corrosion, but water treatment, it is shown, often prevents corrosion of sheets, flues, etc. Seven roads report water treatment increasing repairs to valves and packing, due principally to boiler foaming. Others report no increase in repairs. All roads using water-softening plants report great increase in mileage between flue setting and boiler repairs, some roads reporting as high as 300 per cent. An average increase in mileage of over 100 per cent is given. None of the roads report using mechanical water purifiers, although some report as having experimented in the past, but not using same at the present time. Sixteen of the roads report having regular rules governing the washing of boilers, and the majority report that they comply simply with the Interstate Commerce Commission's instructions as to washing boilers."

In addition to compiling these facts, the committee offered a general code of instructions for washing boilers. Under this heading the following was submitted:

"Boilers are washed for two general reasons:

"First. To remove the accumulation of mud or scale and prevent the overheating of fire-box plates and flues.

"Second. To remove the slime and sludge or other matters which, if allowed to remain, will cause foaming, and also to wash from all parts any injurious concentrates that may have a tendency to cause corrosion.

"The frequency of wash-outs and the number and location of wash-out holes largely depend upon the construction of the boiler and the conditions under which it is being operated, and the performance of the boiler during operation, if it is good, indicates that the wash-out requirements are being met with, while a poor performance indicates the opposite.

"1. Frequency of Washing. All locomotives in service must have boilers washed at least once every thirty days, or more frequently if conditions require.

"2. Cooling Boilers. Boilers should be thoroughly cooled before being washed, excepting at points where improved hot water wash-out systems are installed. When boilers are cooled in the natural way without the use of water, the steam should be blown off, but the water must be retained above the top of crown sheet and boiler allowed to stand until the temperature of the steel in fire-box is reduced to about 90 degrees, or so that it feels cool to the hand; then the water is drawn off and the boiler washed. When the engine can not be spared from service sufficiently for it to be cooled in this manner before washing, proceed as follows:

"3. Use of Injector Cooling Boilers. When there is sufficient steam pressure, start the injector and fill the boiler with water until the steam pressure will no longer work the injector. Then connect water-pressure hose to feed pipe between engine and tender and fill the boiler full, allowing the remaining steam pressure to blow through syphon cock or some other outlet at top of the boiler. Open blow-off cock and allow water to escape, but not faster than it is forced in through the check, so as to keep the boiler completely filled until the temperature of the steel in the fire-box is reduced to about 90 degrees, then remove all plugs and allow boiler to empty itself.

"4. How to Wash a Boiler. Remove all wash-out plugs. Begin washing through holes on side of boiler opposite front end of crown sheet. Wash top of crown sheet at front end, using short right-angle crown-sheet nozzle. Then use door sheet and mud ring nozzle to wash between rows of crown bars and bolts at right angles to nozzle, directing the stream toward the back end of crown sheet. After washing through holes near front end of crown sheet, use holes in their respective order toward the back of the crown sheet. The object of this method is to work the mud and scale from the crown sheet toward the side and back legs of the boiler and prevent depositing it on the back ends of the flues.

"5. Washing Crown Sheet. Next wash crown sheet from boiler head, using crown-sheet, door-sheet and filling-up nozzles. When door-sheet and filling-up nozzles are employed, the swivel connection with hose should be used and nozzle should be inserted to the front end of crown sheet and slowly drawn back and revolved at the same time, so as to wash top of boiler and all radial stays or bolts as well as the crown sheet.

"6. Washing Flues. Wash back end of flues through holes in connection sheet, using crown-sheet, barrel, and filling-up nozzles, and revolve same by means of swivel connection when the curved nozzles are used. The same nozzles are to be used and the same system followed when washing any part of the flues or feed-water heater flues.

"7. Washing Back Head Water Spaces. Wash the water space between back head and fire-box door sheet through the holes in back head with filling-up nozzle, being careful to remove all scale and mud above and below fire-door hole.

"8. Washing Arch Tubes. Arch tubes must be washed and scraped clean with scrapers or pneumatic cleaners every time the boiler is washed. If scale is allowed to form in arch tubes, the metal becomes overheated and bulges are formed, and, if allowed to remain, tube warps out of line with holes, strains are set up and cracks de-

J. W. Small, S. M. P., Seaboard Air Line

W. H. Lewis, S. M. P., Norfolk & Western; F. O. Walsh, S. M. P. & E., Georgia Railroad

R. W. Schulze, Supt. Car Dept., Frisco System

J. J. Waters, S. M. P., Pere Marquette; Chas. H. McCormick, Standard Heat & Ventilation Co.

L. A. Hoerr, Pres., Western Railway Equipment Co.

W. L. Wilt, Chief Clerk to S. M. P., Pennsylvania Lines West, Chairman Sub Committee on Compensation for Cars

velop, and the tube is very dangerous and liable to pull out or explode. Therefore a locomotive should not be allowed to leave a terminal with dirty arch tubes, and all concerned are instructed to strictly comply with the rule.

"Note.—The condition of an arch tube as to scale on the water side can readily be determined by the presence of clinker adhering on the fire side. If an arch tube is clean on the water side, it will be clean and smooth on the fire side. The condition of fire-box sheets can usually be determined by similar evidence. It may be laid down as a general rule that clean fire-boxes on the water side are clean and smooth on the fire side. Any clinker adhering or sand paper roughness on the fire side indicates scale formation opposite.

"9. Washing Side-sheet Water Spaces. Now return to holes on side of boiler opposite crown sheet, using boiler-barrel and filling-up nozzles, and revolve same so as to thoroughly wash down side sheets and staybolts, making sure that all spaces on side of fire-box are clear of mud and scale. Then wash through holes near check valves near front end of boiler, using crown-sheet, boiler-barrel and filling-up nozzles with swivel connection.

"10. Washing Barrel of Boiler. Then wash through hole in bottom of barrel of boiler near the rear end, and wash toward the front end. If engine has no mud drum, wash toward the throat sheet with boiler-barrel and filling-up nozzles. Then use straight nozzle directly against the flues, reaching as great space as possible in all directions. Then use the bent nozzle through the front hole in bottom of barrel, and also the straight nozzle in same manner as above, until certain that the flues and spaces between the flues and barrel are as clean as it is possible to make them.

"11. Washing Mud Ring. Then use boiler-barrel and filling-up nozzles in the side and corner holes of water legs, revolving same thoroughly to clean the side sheets, and finally clean off all scale and mud from the mud ring by means of straight nozzles in the corner holes.

"12. Inspection After Washing. It must not be assumed that because clear water runs from the holes that the boiler is cleaned, but all spaces must be examined carefully with rod and light, and, if necessary, use a pick, steel scraper or other tools, to remove accumulated scale.

"13. Filling Boilers. When cooling and filling boilers, they must be filled through the injector check. The injector steam pipe valve at the fountain must be closed. Filling up boilers through blow-off cocks will not be permitted except at hot water boiler washing plants and when hot water is being used."

Other Reports

Other committee reports included Design, Construction, and Inspection of Locomotive Boilers; Maintenance and Operation of Electrical Equipment; Smoke Prevention; Dimensions for Flange and Screw Couplings for Injectors; Counterbalancing; Forging Specifications; Locomotive Headlights; Revision of Standards and Recommended Practice; and Fuel Economy.

An individual paper on the Variable Exhaust was also presented. In future issues, as space may permit, reference will be made to the more important of these committee reports and papers.

Subjects

The committee on subjects for the 1916 meeting of the association submitted the following:

1. Equalization of long locomotives, so as to secure the most effective guiding from the trucks both leading and trailing.

2. Tender Trucks: Best practice and type of tender truck for passenger locomotives. Has a swing truck any advantage over a rigid truck?

3. Reciprocating and Revolving Weights: Committee to report on possibilities of lightening.

4. Transmission of electric power from motors to driving wheels of electric locomotives. Committee to report on the progress in this direction.

5. Use of pyrometers on superheater locomotives.

6. Piston valves, rings and bushings. Best material and sizes, with particular reference to superheated steam.

7. Metal pilot designs.

8. Modernizing existing locomotives, which can then remain in service for ten or fifteen years.

That the following subjects be assigned for topical discussion:

1. Advantages, if any, of compounding superheater locomotives.

2. Side bearings on tenders.

3. Tender derailments: Causes and remedies.

4. Road instruction for enginemen and firemen.

5. Cross-head design.

This report was duly referred to the executive committee.

Election of Officers

The last order of business at this session, following the reports of the temporary committees, was the election of officers, which resulted as follows:

President: E. W. Pratt, assistant superintendent motive power, Chicago & Northwestern Ry., Chicago.

First vice-president: William Schlafge, general mechanical superintendent, Erie Railroad, New York city.

Second vice-president: F. H. Clark, general superintendent motive power, Baltimore & Ohio R. R., Baltimore, Md.

Third vice-president: W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific Ry., Chicago.

Treasurer: Angus Sinclair, 114 Liberty street, New York city.

Members of the executive committee: J. F. DeVoy,

W. W. Griswold, Pur. Agt., Wheeling & Lake Erie; Geo. A. Post, Standard Coupler Co.; R. D. Gallagher, Jr., Standard Coupler Co.; E. H. Walker, Standard Coupler Co.

A. E. Crone, R. C. Fraser, S. A. Crone and E. Strassburger, Buffalo Brake Beam Co.

O. F. Ostby, Commercial Acetylene Railway Light & Signal Co., New President, R. S. M. A.; J. C. Currie, Nathan Mfg. Co.

G. E. Parks, Mech. Engr., Michigan Central; Percy Hauser, Fore., Office of Mech. Engr., Pennsylvania Lines

M. J. McCarthy, S. M. P., B. & O. S. W.

F. W. Busse, Chief Clerk to S. M. P., Baltimore & Ohio; O. C. Cromwell, Mech. Engr., Baltimore & Ohio

Chicago, Milwaukee & St. Paul Ry.; J .T. Wallis, Pennsylvania Railroad; C. H. Hogan, New York Central R. R.

The past-president's badge was then presented to Mr. Gaines with appropriate remarks by W. E. Symons, and the convention adjourned.

WORKING UP OLD SCRAP

By A. Bennett

All the broken parts of locomotives and cars from all over the Milwaukee system are shipped to the shops at Milwaukee and sorted by the store department, then taken to the rolling mill to be rolled into required sizes.

Three sets of flat rolls, two sets of round rolls and a set of emergency rolls that will turn out either flat or round are available. The largest size flat rolls work up broken arch bars, transomes, pockets and all pieces not too large for the rolls. On the small flat rolls, waste pieces from boiler and tank steel and also a good grade of scrap iron are handled. The combination flat and round rolls are used only when there is a large accumulation of small flat and round pieces, which are worked up without changing the rolls. The rolls make the following standard sizes available:

Flat.	Flat.	Round, Diameter.
5 x 1⅜	3½ x ¾	2⅝
5 x 1¼	3 x 1	2½
4½ x 1¼	3 x ⅞	2⅜
4½ x 1⅛	3 x ¾	2¼
4½ x 1	2¾ x ¾	2⅛
4 x 1	2½ x ¾	2
4 x ⅞	2¼ x ⅝	by 1-16's
3½ x 1	2 x ⅝	down to ¾
3½ x ⅞		

The flat iron is used for running board brackets, foot board hangers, wrenches, valve-rod keys, caps for flexible stay bolts, slab and flat spring hangers. and the round iron for bolts, studs, stay bolts, sleeve for flexible stay bolts, and any other purpose for which its sizes and grades are available. The waste from the rolled iron is taken care of at the furnaces, of which there are eight with steam hammers, one 6,000 lb., three 5,000 lb., three 3,000 lb., and one 2,500 lb. Small scrap iron is bundled 14x9x9 in., heated and hammered in slabs of different sizes. These slabs are then hammered together and worked into the best hammered iron.

This hammered iron is available for all forgings such as frames, driving and truck axles, main and side rods, crank pins, piston rods, mud rings, and all the motion work for the new locomotives we build. All these forgings are finished at the furnace, with the exception of the frames and mud rings, which we have to put together at the fire.

All the scrap locomotive and car axles are worked up to the very best advantage. From the large steel axles we forge crank shafts, hydraulic jacks, valve bushings, hammer dies and shear blades for our wood cutting machine, dies for forging machines and other large forgings.

From the small steel axles we make our crank shafts for motor cars, crank-pin collars, plates, rod washers and numerous other forgings. The waste from the steel axles and steel bridge bars is bundled up and worked into follower plates. All steel forgings are heat treated.

From both the large and small iron axles we forge all the fulcrum arms, equalizers and tie rods, which are finished in dies at the furnace hammers. All the waste pieces are bundled up and worked into slabs again. This is the way we have of disposing of our scrap material. We also heat treat our small iron forgings.

WHY I DON'T GET HURT

By Nit Wit

(1) Because before crossing railroad tracks I look in both directions for approaching cars or engines. (It takes a few seconds longer, but it may be the means of preventing my wife from becoming a widow.) (2) I don't walk on the tracks unless I have to because the time table does not indicate that they should be kept clear for my convenience. (3) I watch my feet when stepping on or off the transfer table when in motion because I can attend better to this than the operator.

(4) I always close both angle cocks before attempting to part the air hose when train line is charged. for the reason that an air hose coupling cannot be reasoned with when knocked against my head by the action of the escaping air. (5) I always cut-out a brake before doing any work on the rigging because I value my hands and fingers and I want to leave the hospital for people that really need it. (6) I do not jump on or off cars or engines while in motion just to show Jimmy Brown & Co. my athletic talents.

(7) When working under or about a car or dead engine in a yard, I put up a blue signal as per rule 26. This may be poor business from the undertaker's point of view, but not from mine. (8) Before I go to work on a scaffold I ascertain whether or not it is in safe condition, properly adjusted and fastened. This precaution may save the doctor a trip to the shops. (9) In jacking up cars or engines I examine the blocking and see that the jacks are on a good foundation, because the company pays me to do my work carefully and has a sign above the office door: "Safety First."

(10) When working on a drill press, I clamp down properly the piece to be drilled before commencing, thereby saving drills and an undesired vacation for myself. (11) I always use goggles when working on an emery wheel or at a lye vat because I intend to use my eyes for the full term of my natural life. (12) I don't try to carry on a conversation when working on a lathe or other machine that needs all my attention.

(13) I don't post myself in front of the blow-off valve when the round house men are about ready "to blow her off." (14) When cutting rivets I protect those around me from getting injured by "flying" rivet heads, by placing a bag or other soft material over the rivet head for a shield or fender. (15) When painting with lead paint I am particularly careful to wash my hands and clean my nails at least three times a day, because I don't want to become a victim of painters' colic or lead poisoning.

The Erie has given a contract to the Corning Building Company, Corning, N. Y., for building a new station at Ridgewood, N. J. Another contract has been given to Arthur McMullen, New York, for constructing a pedestrian subway and the approaches to the new station, also for the paving, etc.

Mrs. A. Fenton Walker, Canadian Railway & Marine World

O. D. Buzzell, Gen. Fore. Car Dept., Sante Fe, and Wife

Chas. N. Swanson, Supt. Car Dept., Sante Fe

J. A. W. Brubaker, Brubaker & Bros.

J. J. Gainey, M. C. B., C. N. O. & T. P.; W. M. Ellis, Fore. Car Dept., C. N. O. & T. P.

F. P. Huntley, Vice Pres., Gould Coupler Co.; Clarence Rood, Gould Coupler Co.; John Mackenzie, Johnson Wrecking Frog Co.; Geo. R. Berger, R. M. Shedd, W. F. Richards and Geo. B. Young, Gould Coupler Co.

Master Car Builders' Association

Condensed Report of the Annual Convention, Held at Atlantic City, June 14, 15 and 16

In the following pages will be found a portion of the papers presented at the annual convention of the Master Car Builders' Association. Because of the limited space available, only a part of these papers will be reprinted at this time. Some of the more important papers will be taken up in future issues of the *Railway Master Mechanic*.

Report of Committee on Brake Shoe and Break Beam Equipment

The report of this committee was confined almost entirely to the matter of brake shoes. A small portion of the paper, however, was given up to the very important question of brake beams, and, as being of more immediate value to our readers, it is republished in the following:

Revision of Specifications for Tests on Brake Beams.—Last year this committee recommended that a new method of procedure for testing No. 2 brake beams should be adopted to take the place of those given in the M. C. B. proceedings for 1913 on page 854. This change involved primarily the use of certain set and deflection readings instead of tests to destruction. This recommendation was approved by the convention and made the subject of letter ballot. It received a majority of the votes cast, but lacked a few votes of the necessary two-thirds. The committee believes that this was due to a misapprehension and desires to state that the proposed test is no more severe than that at present in use, but is much more in line with accepted practice in the matter of testing units and structures. The tests recommended would determine the stiffness of the beam at the working limit and also at or near the elastic limit of the material. The expression "until failure occurs" of the beam is meaningless as applied to a built up structure of wrought iron and soft steel. It is not possible for any one to say just when the beam has failed or when it has been tested to destruction. It is entirely possible, however, to say that it shows too much deflection at the working load or that it takes too much permanent set at some greater load.

The committee's attention was frequently called to the fact that there should be some notation and specifications for beams heavier than the No. 2. After carefully considering these communications and the various weights of beam in common use, the committee decided to recommend a classification of beams heavier than No. 2 to be known as No. 3, 4, etc. To properly determine the class in which such beams belong, the committee recommended the following specifications and tests for Nos. 1 and 2 brake beams as given in the M. C. B. proceedings for 1913, page 854:

1. "Initial Load.—Apply an initial load corresponding to the number of the beams as in the second column of the accompanying table, then reduce to zero. Apply a load of 500 pounds and reset the deflection instrument to zero.

2. "Test Load.—Apply a test load corresponding to the number of the beam as in the second column of the accompanying table, and under this load measure the deflection, which is desired to be $\frac{1}{16}$ inch or 0.0625, but should not exceed 0.07 inch.

3. "Test for Set Load.—The beam must then be loaded to the load shown in the third column of the table after which the permanent set shall not exceed 0.01 of an inch.

4. "Total Deflection Test.—The brake beam should stand a total motion of the head of the machine of not less than two inches without failure at any point.

Number of Beam.	Deflection Load.	Set Load.	Ratio.
1	6,500	14,000	47
2	12,000	24,000	50
3	18,000	30,000	60
4	24,000	36,000	66.7
5	30,000	42,000	71.2
6	36,000	48,000	75

"It will be noted that in each case the test load corresponds with the working load of the beam and that these loads, with the exception of the No. 1 beam, vary at intervals of 6,000 pounds. Further, that the set load will correspond practically to the elastic limit of the material. The last column of the table shows the ratio existing between the two loads."

In recommending these tests, the committee called attention to the fact that this is not an attempt in any way to standardize details of brake beams, but merely to determine by the methods at present common to the best testing laboratories whether the beam in question is stiff enough for the class to which it is assigned. Attention was called in the report of the committee last year to the desirability of some further specifications concerning the weight of struts and other elements of the beam. The committee at that time reported that specifying minimum weight would not solve the difficulty, but that some specification defining the sizes of the heads and struts should be determined. The committee expressed itself as believing that much light would be thrown on this problem by comprehensive tests of the various beams in use, employing the Berry strain gauge or some similar device to determine the distortion of various elements of the beam as different points and the corresponding stresses. Such

W. O. Duntley, Pres., Chicago Pneumatic Tool Co.; Tom Aldcorn, Chicago Pneumatic Tool Co.

R. J. Faure, Asst. to Gen. Mgr., Commercial Acetylene Railway Light & Signal Co.

W. E. Sharp, Grip Nut Co.

J. A. Costello, Geo. L. Weiss, W. B. Waggoner, Cleveland Car Specialty Co.

Thomas Madill, Sherwin-Williams Co.; E. J. Arlein, W. H. Coe Mfg. Co.

L. A. Richardson, Mech. Supt., Rock Island; Peter Maher; W. J. Tollerton, Gen. Mech. Supt., Rock Island; G. W. Lillie, Mech. Supt., Rock Island

an investigation would show the presence of weak elements and also of those which are stronger than necessary. An investigation of this kind would afford data for reducing excessive weight without loss of strength. The committee recommended that tests of this character be undertaken by the association next year and asked for instructions on this point.

The committee received some criticism of the 500-pound initial load in the proposed specifications, it being claimed that in the case of light non-adjustable beams such a load might influence the acceptance or rejection of the beam. To settle this point, C. D. Young, of the committee, tested several beams of this character, using the 50-pound initial load and the 500-pound load. The results of these tests showed that this criticism is unfounded. The committee urges that a load of at least 500 pounds is necessary with the class of machines generally used for testing brake beams, in order to take up lost motion in the machine and in the beam itself, and that it is so small compared with the working load of the beam as not to influence the result otherwise. The committee further recommended that in testing beams which have adjustable heads, the heads be removed before the beam is tested, so as to avoid unnecessary lost motion during the test.

The lively discussion forthcoming relative to this report showed a very general realization of weaknesses of the brake beams commonly applied to cars, and of the inadequacy of the means by which they are attached to the car. The desire for improvement in these particulars was shared in by all members discussing the report. As for the brake beams proper, it appears that the present specifications are insufficient in that they will admit a beam capable of enduring the prescribed static tests and which, while they may be possessed of a sufficient margin of strength in the tension and the compression members, are apt to develop weaknesses in the struts and heads against which the purchasers under the present arrangement have no defense. This condition has led to an insistent demand for a more perfectly designed beam as regards these members, so much so that there appears to be a strong sentiment in favor of some form of properly designed standard beam, or at least one in which the heads and struts, as well as the beam as a whole, come under definite specifications and conform to such dimensions as will permit a general process of interchange. There was a considerable argument also in favor of discarding further consideration of the No. 1 beam, leaving the field to the No. 2 beam exclusively in so far as the standards and recommended practices of the association are concerned.

Not only in the beam and its several parts was there found cause for dissatisfaction with present conditions, but also was this true in the matters of the brake shoes, the method of fastening and the methods of suspending them in the trucks. While the practice of attaching dependable safety loops was strongly advocated and is standard practice on the New York Central R. R., greater preference on the part of others was expressed in favor of applying the expense of such procedure to the task of improving the hangers themselves. The necessity for attention to this particular matter was considered as being so urgent as to call for committee action at next year's convention. After some discussion as to whether the subject should be referred to the brake beam or to the truck committee, it was voted to leave it in the hands of the executive committee for disposal. In concluding the discussion on this report the convention formally voted to accept the committee's recommendations respecting the matter of revised specifications, as above noted.

Report of Committee on Draft Equipment

Statistics gathered by this committee from among the members of the association made up the report of the committee.

Briefly, it was stated that 60 per cent of the total number of cars reported are of steel center sill construction and are equipped with friction draft gear from a minimum of 100,000 pounds to a maximum of 260,000 pounds capacity. The capacity of these cars varies from 80,000 to 120,000 pounds. The question is involved whether the construction of a car is taken into consideration when a decision is being reached as to the capacity of the gear to be applied. It is evident that a draft gear of low capacity necessitates a better construction of car in order to take care of the shocks, which are meant to be absorbed by the gear. Eighty per cent of the total replies show preference for a friction draw gear on new equipment. Thirty-six per cent of the replies express a preference for more coupler travel than the present standard of 2¾ inches between coupler horn and striking plate. The matter of keeping up nuts on drawbar carry-iron bolts is a great source of trouble. Almost all who advise no trouble in that respect are using nut locks, while some of the largest roads are overcoming this trouble by placing these bolts in shear instead of in tension, as has been the general practice.

By way of disposing of the foregoing report, it was referred to the incoming executive committee.

Impact Between Freight Cars in Switching Service

(An Individual Paper by Louis E. Endsley)

One of the most important papers that has been presented before the Master Car Builders' Association for some years was given by Professor Endsley, and it is given verbatim in the following. The immediate importance of this paper is the reason for its being published in this

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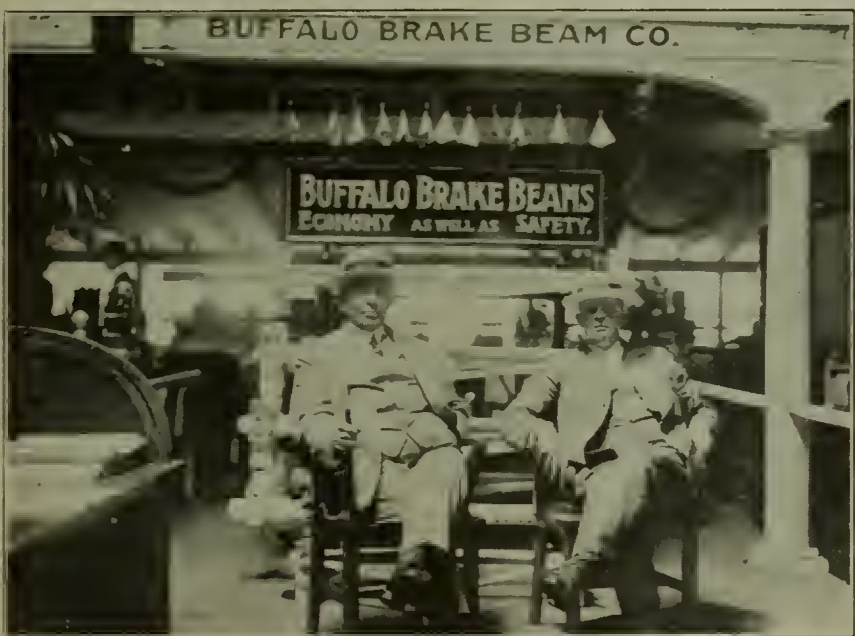
T. H. Russum, Supt. Pass. Car Dept., Baltimore & Ohio; J. S. Sheafe, M. M., S. I. R. T.; F. S. Gallagher, Asst. Engr., New York Central



R. D. Smith, S. M. P. & R. S., Boston & Albany; J. B. Canfield, M. M., Boston & Albany

F. W. Brazier, F. R. S., N. Y. C.; T. J. Burns, S. R. S., Michigan Central; G. E. Parks, M. E., Michigan Central (The oldest and youngest S. C. D.'s on the N. Y. C. and the youngest M. E.)

Charles E. Fuller, Jr.

John Mackenzie, Johnson Wrecking Frog Co.; M. G. Brown, S. M. P., Gulf & Ship Island; J. W. Fogg, Boss Nut Co.

issue, and the very large importance of the subject is the reason for our discussing it more at length later on.

INTRODUCTION

The subject of impact between freight cars in switching service has been a subject of much interest to all railroad men for some years, especially as the capacity and weight of cars have increased. But so far as the writer knows, no definite information has been published in regard to just how much this force of impact really is.

Fig. 1—Method of Mounting Chronograph in Relation to Car Under Test

PURPOSE

The purpose of these experiments was to determine this force of impact by obtaining the acceleration of the car during the impact blow.

DESCRIPTION OF THE CHRONOGRAPH

The instrument used to obtain the acceleration of the car during the impact is shown in Figs. 1 and 2. It will be seen that it consists of a cylinder A, mounted on two supports B and B. These supports also carry a rest C, upon which the slide D moved. This slide had mounted in it a lead-pencil F. The slide was so constructed that it could be connected to the car by means of the rod G. The cylinder A could be driven at almost any desired speed by the motor H, which received its current from the six-volt storage battery. The speed selected for these tests was 45 revolutions of the cylinder per minute. As the cylinder was 20 in. in circumference, this gave a speed for the paper of approximately 15 in. per second.

METHOD OF TESTING

In preparation for a test, a string of eight or ten cars were placed on a track that had just sufficient grade to keep a car in motion after it had been started and not enough to accelerate the car. The brakes on the last two cars on the down-grade end were set and a locomotive was coupled on to the up-grade end and the slack was pushed in until just the draft-gear movement was left between each car. The end car was then disconnected and pulled up the track some distance, the chronograph having been connected to the end car of those standing as shown in Fig. 2, the motor was then started and the drum allowed to revolve. The car that the en-engine had pulled up the track was pushed down the track with the engine disconnected. The car was then allowed to drift into the string of stationary cars. The speed of the moving car was determined by stop-watches, the time of the movement of the last 30 ft. being noted by two stop-watches. The velocity and acceleration of the first standing car was obtained from the record made on the cylinder A of the chronograph.

Fig. 2—Detail Arrangement of Chronograph and Attachment to Car

The above tests were made on the Norfolk & Western 90-ton cars and the Pennsylvania 55-ton cars, both kinds of cars being tested light and loaded. The tests on the Norfolk & Western cars were made at Roanoke, Va., and the test on the Pennsylvania cars was made at Conway, Pa.

METHOD OF OBTAINING THE MAXIMUM FORCE

For the purpose of distinguishing the different cars referred to in the paper, the moving car will be called A, the first car of those standing, B, the second standing car, C, the third standing car, D, etc.

The instrument was connected to car B, which was the first car in the cut of standing cars. It is a well-known law in physics that if you know the weight of a body and its acceleration, you can determine the force acting on the body. In each case the weight of the car and load was known, and the acceleration was determined from the curve drawn on the drum. The speed of the drum being 15 in. per second, the velocity of the car was determined for each .01 of a second lapse of time and the difference in velocity for each .01 of a second would give the acceleration per hundredth of a second. As this was a very short space of time, the acceleration for each

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Mrs. R. B. Kendig; Mrs. Eugene Chamberlain; Mrs. R. C. Shool; Roy C. Munro, Acme Supply Co.; J. T. Geoghegan, Queen & Crescent Route; S. W. Midgley, Acme Supply Co.; W. L. Conwell and D. W. Pye, Transportation Utilities Co.

A. J. Candlin, Canadian Car & Foundry Co.; S. W. Midgley and R. C. Munro, Acme Supply Co.

B. R. Moore, S. M. P., Duluth & Iron Range

Mrs. T. H. Russum; Mrs. W. S. Chamberlain; Mrs. A. G. Sandman; Miss Sandman; Mrs. F. D. Waller; H. B. Chamberlain, Transportation Utilities Co.; Roy C. Munro, Acme Supply Co.; W. L. Conwell, D. W. Pye, Frank Grigg, Transportation Utilities Co.; S. W. Midgley, Acme Supply Co.

W. B. Leach, Pres., Hunt Spiller Mfg. Corp.; F. F. Gaines, S. M. P., Central of Georgia Railroad (President Master Mechanics' Association 1914-1915)

.01 of a second was assumed to be constant. This acceleration, as obtained from the drum, was reduced to feet per second per second and the following formula applied:

$$F = \frac{W}{g} a$$

in which F equals the force in pounds on the car, W equals the total weight of the car, g equals gravity taken as 32.2, a equals the acceleration in feet per second per second as taken from the curve drawn on the drum. There might be some question as to whether the trucks should be included in the weight of the car, but as in most cases the maximum force occurred after the car had moved approximately ¾ of an inch, it would seem that the trucks would be in motion by the time the car

WEIGHT OF CAR B 60 000 LBS

VELOCITY OF CAR 'A' IN FT PER SEC	SPEED OF CAR 'A' IN M.P.H AT IMPACT	MAXIMUM VELOCITY OF CAR 'B' IN FT PER SEC	MAXIMUM SPEED OF CAR 'B' IN M.P.H	KINETIC ENERGY IN FOOT-POUNDS OF CAR 'A'	MAXIMUM KINETIC ENERGY IN FOOT-POUNDS OF CAR 'B'	MAXIMUM PRESSURE FROM ACCELERATION CURVE
I	II	III	IV	V	VI	VII
3.26	2.22	1.25	.85	9900	1460	101,000
4 62	3.15	2.62	1.78	19800	6400	164,000
5.00	3.41	2.37	1.61	23400	5240	128,800
5.26	3.59	2.77	1.88	25800	7150	181,500
5.56	3 79	2.72	1.85	28800	7000	141,000
6.00	4.09	3.32	2.26	33600	10300	184,500
6.25	4.26	3.33	2.27	36400	10400	204,000
6.25	4.26	3.39	2.31	36400	10700	198,500
7.50	5.12	3.16	2.15	52400	9300	222,000
7.90	5.39	4.46	3.04	58100	18600	313,000
8.83	6.02	4.94	3 36	72800	22700	468.000

Table II—Schedule of Results of Tests on Light Norfolk & Western Cars

body had moved ¾ of an inch, so that the weight of the trucks was included in all results.

RESULTS OBTAINED

Tables 1 and 2 give the results obtained on the light cars of the Pennsylvania and Norfolk & Western, respectively. Tables 3 and 4 give the results obtained on the loaded cars. Column 1 of these tables gives the speed in feet per second as obtained by a stop-watch for the last 30 ft. of movement. Column 2 gives the calculated speed in miles per hour computed from the values in Column 1. Column 3 gives the maximum speed in feet per second obtained by car B during the impact, this car being the first in the string of standing cars. Column 4 gives the maximum speed in miles per hour of car B. Column 5 gives the kinetic energy in foot-pounds of car A at the moment of impact. Column 6 gives the maximum kinetic energy in car B during the impact. This last value is obtained from the velocity curves recorded on the chronograph. Column 7 gives the maximum force in pounds as obtained from the maximum acceleration of car B during the impact. Fig. 3 shows the maximum force between the cars plotted against the speed in miles per hour of the moving

WEIGHT OF CAR 'B' 48800 LBS

VELOCITY OF CAR 'A' IN FT PER SEC.	SPEED OF CAR 'A' IN M.P.H. AT IMPACT	MAXIMUM VELOCITY OF CAR 'B' IN FT PER SEC	MAXIMUM SPEED OF CAR 'B' IN M.P.H.	KINETIC ENERGY IN FOOT-POUNDS OF CAR 'A'	MAXIMUM KINETIC ENERGY IN FOOT-POUNDS OF CAR 'B'	MAXIMUM PRESSURE FROM ACCELERATION CURVE
I	II	III	IV	V	VI	VII
1.35	.92	.67	.46	1355	344	12,600
2.50	1.70	.97	.66	4650	718	30,200
2 86	1.95	1.07	.73	6090	860	32,800
3.57	2.43	1.64	1.12	9500	2030	41,500
3.90	2.66	1.81	1.23	11320	2480	66,750
4.48	3.06	1.99	1.36	14900	2990	60,400
5.00	3.41	2.48	1.69	18600	4640	90,600
5.00	3.41	2.30	1.57	18600	3990	81,750
6.00	4.09	2 90	1.98	26800	6350	107,000
7.15	4.87	3 49	2.48	38100	9200	129,500
8.12	5.54	3.30	2.25	49200	8150	158.500

Table I—Schedule of Results of Tests on Light Pennsylvania Cars

car at the time of impact. That is, the results shown in Column 7 are plotted against those shown in Column 2 of each table. Fig. 4 shows the relation between the weight of the car and the maximum force in impact for speed of two, three and four miles per hour. The values here plotted were taken from the curve in Fig. 3. That is, the pressure at two miles per hour was taken off for each curve in Fig. 3 and likewise for speeds of three and four miles. By an examination of Fig. 3 it is apparent that the maximum force of impact is not directly proportional to the speed, as the curves that represent the average relation in all cases curve up as the speed of the moving car is increased. This, no doubt, is due to the fact that the kinetic energy of the moving car varies with the square of the velocity, and the force of impact would, no doubt, be also proportional to the square of the velocity if the end of each car was of sufficient strength to withstand the force without destroying it partly, but as the force increases, some of the kinetic energy is used up in the destruction of the coupler, draft-gear connection and end-sill connection, from the horn of the coupler coming in contact with the end sills and other giving of the part. Of course, the draft gear absorbs some at each impact, but this is a constant after the draft gear

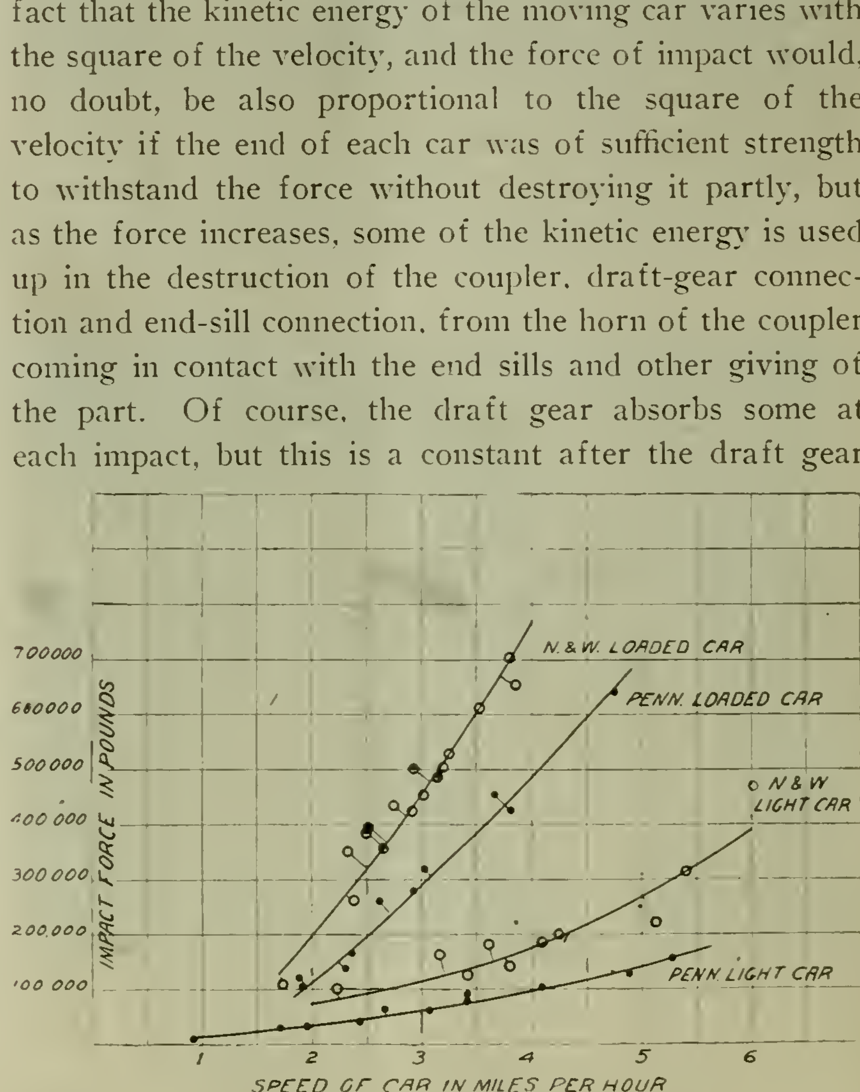


Fig. 3—Chart Showing Relation Between Impact and Speed

K. L. Ernst, National Machinery Co.

S. A. Crone, Pres., Buffalo Brake Beam Co.; T. G. Case, Asst. Gen. Fore., New York Central

W. J. O'Brien, M. M., Kanawha & Michigan; A. N. Lyon, Gen. Supt., Kanawha & Michigan; J. F. Holzemer, Pur. Agt., T. & O. C.

T. H. Goodnow, Supt. Car Dept., C. & N. W.; S. W. Midgley, Sales Mgr., Acme Supply Co.

Miss Nellie Wilt; Mrs. J. M. High; J. M. High, Jr.

B. E. D. Stafford, J. Rogers Flannery, and Chas. Hyland, Flannery Bolt Co.

once goes solid. The loss in each impact is well shown by a comparison of Columns 5 and 6, Column 5 giving the kinetic energy in the moving car and Column 6 the maximum kinetic energy in the first car. That is, the value in Column 6 would also represent the energy retained by the moving car A, and by double the values in Column 6, and subtracting them from Column 5 the loss of kinetic energy for any impact can be determined. This loss in some cases amounts to as much as 70,000 foot-pounds of energy in one test on N. & W. cars. This can only be accounted for by the destruction of some part of the car. During the testing on the N. & W. cars a few impacts were made with the loaded cars that had bumper blocks on the ends of the car. The results are given at the bottom of Table 4. It will be seen that a larger per cent of the kinetic energy is transmitted to car B when the bumper blocks are on, and also the force between the cars is usually somewhat greater. The five

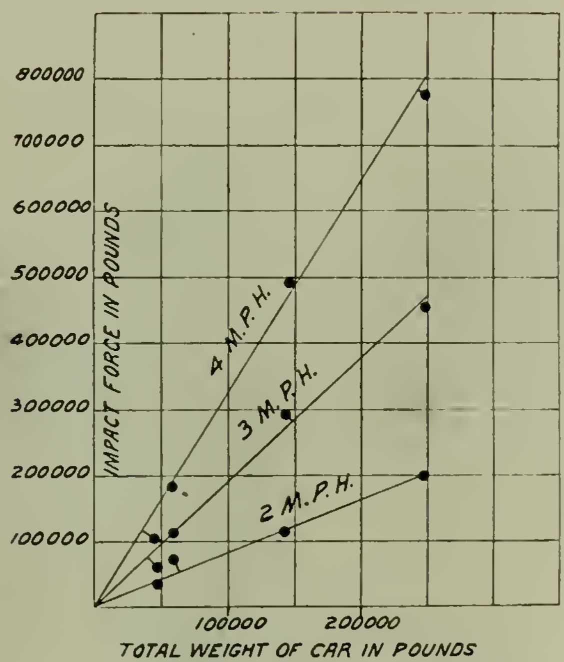


Fig. 4—Chart Showing Relation Between Impact and Weight of Car

points with a cross in the circle in Fig. 3 show the results on the N. & W. loaded cars equipped with bumper blocks. It will be seen that, with the exception of one point, all fall above the average curve. This is, no doubt, accounted for by the fact that the load is distributed over three points and thus a greater force was produced with less destruction than when the couplers and draft-gear connection received all the load. From a study of the value shown in Fig. 4 it will be seen that the maximum force of impact for any given speed is almost directly proportional to the weight of the cars in impact.

An interesting thing, which was plainly shown from the curves made on the chronograph, was the fact that the maximum force on car B occurred always before it had moved 1 in. Car B usually moved from 4 to 12 in. That is, the maximum force on car B occurred before any appreciable force was exerted between cars B and C, and the speed of car B was very slow before cars C and D had any pressure between them and car B was always stopped before the impact between cars D and E occurred. That is, the largest per cent of kinetic energy is taken out of the moving car in the impact between cars A and B, and the greatest damage would be done at this point. So as this force occurred before car B had moved 1 in., the damage to the end of the car would be just as great if only one car was standing as if a dozen were backing it up, provided there was at least 1 in. slack between the first and second cars of the standing ones. Of course, so far as the damage to the center sills at the center of the car, no doubt this damage would be greater if the cars were backed up by other cars. But these results given in this paper seem to indicate that there would be just as great a force between the cars if one car struck another car or struck a string of cars.

While some may doubt that we are getting any such force between the cars, the consistency of the results as shown in the plotting in Figs. 3 and 4, and the fact that the law of gravity is unchangeable and that force equals

WEIGHT OF CAR B 143300 LBS

Velocity of car "A" in ft. per sec.	Speed of car "A" in M.P.H. at impact	Maximum velocity of car "B" in ft. per sec.	Maximum speed of car "B" in M.P.H.	Kinetic energy in foot-pounds of car "A"	Maximum kinetic energy in foot-pounds of car "B"	Maximum pressure from acceleration curve
I	II	III	IV	V	VI	VII
2.75	1.87	1.75	1.19	16.500	6,820	119,100
2.80	1.91	1.71	1.16	17,120	6,510	104,000
3.37	2.30	2.04	1.39	24,800	9,270	137,000
3.45	2.35	2.04	1.39	26,000	9,270	167,000
3.85	2.62	2.32	1.58	32,400	12,000	264,000
4.28	2.92	2.52	1.72	40,000	14,150	278,000
4.42	3.01	2.61	1.78	42,700	15,150	319,000
5.36	3.65	3.26	2.22	62,700	23,700	453,000
5.56	3.79	2.56	1.74	67,500	14,600	426,000
6.98	4.76	3.82	2.60	106,500	32,500	640,000

Table III—Schedule of Results of Tests on Loaded Pennsylvania Cars

WEIGHT OF CAR B 248000 LBS.

Velocity of car "A" in ft. per sec.	Speed of car "A" in M.P.H. at impact	Maximum velocity of car "B" in ft. per sec.	Maximum speed of car "B" in M.P.H.	Kinetic energy in foot-pounds of car "A"	Maximum kinetic energy in foot-pounds of car "B"	Maximum pressure from acceleration curve
I	II	III	IV	V	VI	VII
2.46	1.68	.59	.40	23,300	1,340	110,000
3.41	2.33	1.24	.85	44,600	5,920	353,000
3.49	2.38	1.69	1.15	46,800	11,000	263,000
4.00	2.73	1.86	1.27	61,600	13,300	436,000
4.28	2.92	1.64	1.12	70,600	10,750	425,000
4.42	3.01	1.94	1.32	75,000	14,500	452,000
4.69	3.19	1.69	1.15	84,600	10,950	507,000
4.76	3.25	1.80	1.23	87,200	12,450	530,000
5.17	3.52	2.25	1.53	103,000	19,500	612,000
5.55	3.78	2.40	1.64	116,500	22,100	702,000
5.65	3.85	2.65	1.81	122,500	27,000	655,000
	CAR EQUIPPED WITH BUMPER BLOCKS					
3.66	2.50	1.82	1.20	51,600	13,600	389,000
3.70	2.52	1.80	1.23	52,500	12,450	398,000
3.89	2.65	1.96	1.34	58,100	14,830	359,000
4.28	2.92	2.15	1.46	70,500	17,300	500,000
4.62	3.15	2.61	1.77	82,000	26,200	487,500

Table IV—Schedule of Results of Tests on Loaded Norfolk & Western Cars

Geo. R. Boyce and J. H. Smythe, Lukens Iron & Steel Co.; L. P. Laux, M. M. Lehigh Valley; T. C. Vorhees, Philadelphia & Reading; A. W. Whiteford, Jacobs Shupert U. S. Firebox Co.; Amos Turner, M. M., Lehigh Valley; C. Ducas, Jacobs Shupert U. S. Firebox Co.; H. S. Coleman; G. T. Schaatz; H. B. Spackman

C. A. Methfessal; E. A. Johnson; Mrs. E. A. Johnson; C. N. Thulin; Mrs. C. A. Methfessal; G. E. Watts; H. E. Watts; Mrs. C. N. Thulin; E. E. Thulin, Duff Mfg. Co.

W. E. Rockefellow, Gen. Car Fore., New York Central; C. H. Donahue, Gen. Fore., New York Central; C. F. Fryer, Gen. Fore. Car Dept., New York, Ontario & Western

F. W. Stubbs, Mech. Engr., C. G. W.; F. W. Stubbs, Jr.

L. E. Endsley, Prof. of Railway Engineering, University of Pittsburgh

Stephen C. Mason, The McConway & Torley Co.; Henry Bartlett, Chf. Mech. Engr., B. & M.; E. M. Grove, The McConway & Torley Co.; I. H. Milliken, The McConway & Torley Co.

mass times acceleration, it would seem to prove beyond a doubt that such force does exist.

Before closing, I wish to express my appreciation for the coöperation and assistance rendered in this work by the following men: Messrs. D. F. Crawford and T. R. Cook, of the Pennsylvania Lines West; W. H. Lewis, J. A. Pilcher and H. W. Coddington, of the Norfolk & Western R. R., and W. E. Larsen and C. O. Henry, senior students of the University of Pittsburgh.

Other Reports

Among the important papers and committee reports for which it is impossible to find space in this issue are the following: Specifications and Tests for Materials; Loading Rules; Car Wheels; Car Trucks; Revision of Standards and Recommended Practice; Compensation for Car Repairs; Prices for Labor and Material; Train Brake and Signal Equipment; Arbitration Committee; Settlement Prices for Reinforced Wooden Cars; Couplers; Loading Rules Regarding the Overhead Inspection of Box Cars; Loading Rules Regarding Interline Loading; Train Lighting; Car Construction; and an individual paper on What Is the Value of a Patent? These will be taken up and discussed in future issues at the proper time.

Election of Officers

The technical program of the convention concluded as above, the report of the committee on resolutions was read, and the result of the ballot for officers of the association for the ensuing year was announced as follows:

President, D. R. MacBain, superintendent of motive power, New York Central R. R., Cleveland, O.

First vice-president, R. W. Burnett, general master car builder, Canadian Pacific Ry.

Second vice-president, C. E. Chambers, superintendent of motive power, Central R. R. of New Jersey.

Third vice-president, T. W. Demarest, superintendent of motive power, Pennsylvania Lines West, Ft. Wayne, Ind.

Treasurer, J. S. Lentz, master car builder, Lehigh Valley R. R.

Members of the executive committee, C. E. Fuller, Union Pacific R. R.; F. F. Gaines, Central of Georgia R. R., and I. S. Downing, Cleveland, Cincinnati, Chicago & St. Louis R. R.

Coincident with the election of officers, a nominating committee for the ensuing year, consisting of Messrs. Gaines, Brazier, Hennessey, Clark and Gibs, was chosen.

Messrs. Garstang, Orchard, Buker, Grieve and Crone were elected to life membership and Prof. L. W. Wallace, Purdue University, was elected to associate membership.

After the presentation of the past-president's badge to the retiring president, D. F. Crawford, by Geo. A. Post, the convention adjourned.

CARS AND LOCOMOTIVES

The Government Railways of the Union of South Africa are reported to have ordered 6 narrow gauge locomotives from the Baldwin Locomotive Works.

The Missouri, Oklahoma & Gulf Railway contemplates the purchase of 6 Mikado (2-8-2) locomotives.

The Montour Railroad has ordered 3 superheater Mikado locomotives (2-8-2-S) from the American Locomotive Co.

The Toledo-Detroit Railroad has placed an order with the American Locomotive Co. for 2 consolidation freight locomotives (2-8-0). The cylinders will be 21x28 inches, driving wheels 56 inches, and weight 160,000 pounds.

The St. Paul Bridge & Terminal has ordered one Mogul type locomotive from the American Locomotive Co. This locomotive will have 20 by 26 in. cylinders and 51-in. driving wheels.

The Seaboard Air Line Railway is reported in the market for about 100 machine tools.

The Baltimore & Ohio Railroad reported in the market for 2000 50-ton hopper cars has issued inquiries for such equipment. These cars are for the company's own lines and not for the Cincinnati, Hamilton & Dayton Railway.

The Buffalo, Rochester & Pittsburgh Railway is inquiring for 900 steel underframes.

The Chicago & Northwestern Railway is inquiring for 300 automobile cars for the Chicago, St. Paul, Minneapolis & Omaha Railway and has also entered the market for 50 caboose on which Bettendorf underframes are specified. It is reported that this road will purchase 300 refrigerator and 150 automobile cars additional.

The Chicago & North Western Railway has ordered 2 observation-lounging and 3 observation-buffet-lounging cars from the Pullman Company.

The Chicago, Burlington & Quincy Railroad has ordered 2000 40-ton box cars, the American Car & Foundry Co. and the Bettendorf Company being awarded 1000 cars each.

It is reported that the Erie Railroad will enter the market for freight cars.

The Havana Central Railroad has ordered 100 30-ton box cars and 10 30-ton cabooses from the Standard Steel Car Co. Orders have also been placed for 50 30-ton flat cars.

The Illinois Steel Co. is inquiring for 10 tank cars.

The Philadelphia & Reading Railway, according to report, contemplates the purchase of freight cars.

The Wabash Railroad has this week been taking figures on metal draft arms and draft gear, to be used in rebuilding 1600 cars. It is now understood that in about two weeks, orders will be placed for these appliances for 1000 cars, the remaining 600 having been postponed to some time in the future.

A Study of the Apprentice System

A Comparison of the Methods Followed and Courses Supplied on a Number of Railways

By A. G. CROCKER, Asso. Mem. Am. Soc. M. E.

There has been much information published on apprenticeship systems on individual railways, but we believe a comparison and study of the methods used on various railways will be not only interesting but instructive. The data presented should make it possible to draw general conclusions which can be used to improve the systems used on some of the roads, and also provide a sound basis for founding the apprenticeship system where not now in use.

Delaware, Lackawanna & Western

The number of apprentices employed by the Lackawanna Railroad is in the proximity of 250. These are distributed between Scranton, Pa., Kingsland, N. J., and East Buffalo, N. Y.

All boys entering the service of the Lackawanna must be at least 16 years and not over 21 years of age. They are required to pass an entrance examination consisting of whole numbers, fractions and decimals. A physical examination is also necessary, for the work that these boys must do requires strength as well as good eyesight and hearing.

During the first three months of the course the foreman or shop instructor generally finds out whether or not the boy has the necessary qualifications to make a good mechanic. These three months are considered probationary months, and whether the boy continues with the course or is dropped depends entirely upon himself.

The Lackawanna conducts a day school for all apprentice boys, each being given three hours a week instruction, for which time he is paid his regular rate by the company. The instruction given consists of blue print reading, mechanical drawing and shop mathematics. These courses are arranged to give the boy the greatest amount of information regarding his chosen work. The object of the apprentice school is not to make engineers, but rather to produce first class mechanics.

Two technical instructors handle this work, while each shop has a practical instructor whose duty it is to teach the boy the practical side of his trade as well as to see that all boys are changed periodically from one class of work to another. Each school-room is equipped with charts, blackboards, desks, drawing cabinets, etc.; in fact, all things necessary to make a complete and up-to-date school room. The length of the apprentice course is four years of 2,500 hours each. The length of time that a boy remains on each class of work depends upon his ability to learn.

Between the years of 1910 and 1914 70% of the boys who entered the service completed their courses. The reason for the majority of the boys not completing the course was on account of their parents moving away from the city.

During 1914 50% of the boys who graduated remained in the service of the Company.

No bonus or prize is offered for completing the course, but a diploma is given which states that the boy has successfully completed his apprenticeship. Complete records are kept of the boys' standing in the shop and of the different classes of work they have been on throughout the four years.

Chicago, Milwaukee & St. Paul (Lines West)

The Chicago, Milwaukee & St. Paul employs about 30 apprentices with an average age limit of 21 years. Their education is equal to that of the eighth grade course in grammar school. No special physical qualifications are required. There is no probationary period before apprentices are finally accepted and no educational advantages are given them. There are no apprentice school instructors and no shop instructors, therefore no school rooms.

The length of the apprenticeship is 4 years and consists of 3½ years in the shop and 6 months in the roundhouse. Eighty per cent complete the apprenticeship. The small pay given the apprentice is the general reason for many leaving before they have completed their course. Fifty per cent of the graduates remain in the service, while ten per cent are advanced to positions of authority in the shops.

No special encouragement, however, is given them to remain in the service and no bonus is offered to complete the apprenticeship. From a commercial standpoint the apprentice courses have proven to be entirely satisfactory. Complete personal records are kept of all apprentices, but no rewards for high standings are given. A certificate is given upon the completion of the courses. The number of apprentices employed does not vary perceptibly, no yearly increase being noted. The Chicago, Milwaukee & St. Paul does not employ special apprentices.

Illinois Central

The Illinois Central employs 128 apprentices; 122 regular and 6 special, ranging in age from 16 to 23 years. They are required to be able to read and write and understand the rudiments of arithmetic, and must also be in good physical condition.

The company does not grant them any special educa-

tional advantages and has no apprentice school instructors. However, one shop instructor is employed who has full charge of all apprentices. There are no school rooms. The apprentices do not attend school during working hours, yet some probably attend night-schools of their own free will.

Regular apprentices are indented for four years of 300 days each with the time divided equally so that boys may become efficient in all departments. Eighty-five per cent complete the apprenticeship course and the general reason for the failure of the remaining 15 per cent to finish is that they have become dissatisfied with the trade which they have selected. Approximately 90 per cent of the graduates remain in the service, but none as yet have been advanced to positions of authority in the shops.

Boys are encouraged to stay in the service of the company after graduating and special inducements are made to them by giving them journeyman's rate of pay after properly qualified. If not properly qualified they are graded as the judgment of the foreman dictates, with the inducement that should they be worthy of an advance later on they will be granted this consideration. Merit and ability also govern future advancements in the company's service. The results obtained from the courses of apprenticeship have more than justified the trouble. A complete record is kept of all apprentices when entering the service, when graduating from the apprentice course, when employed as journeyman and during all other periods.

No certificates or diplomas are given other than the regular apprentice papers, signed by the general superintendent of motive power, showing that the boy has served his apprenticeship in whatever trade he may have selected. The yearly increase in the number of apprentices employed is 24.

The Illinois Central employs 6 special apprentices. All graduates of technical colleges or manual training schools who have entered such school prior to the age of 21 may enter the service of the company as special apprentices. The length of special apprenticeship is 2 years, divided on a more advanced stage of work than that given to the regular apprentice. In other words, shorter time is allotted to passing the special apprentice through the various departments than that of the regular apprentice. The object of this course is to give the special apprentice a thorough training if possible. Ninety per cent graduate, while 75 per cent remain in the service. The same inducement is given to the special apprentice as that given to the regular apprentice. If qualified their efforts are rewarded by advancement. The special apprentice course has also proven very satisfactory, yet the number of graduates employed does not increase yearly to any great extent.

Canadian Government Railways

The Canadian Government Railways employ 80 apprentices. All applicants must be between the ages of 17 and 21 years, and must be able to read and write either English or French, and know the first four rules of arithmetic. They are also required to pass a medical examination. Apprentices showing no aptitude to learn the trade after serving one year are either dismissed or transferred. The foreman and others in authority advance the apprentices as fast as possible in all branches of the trade. The length of the apprentice course is four years of 2,400 hours each.

Machinist apprentices are given instructions as far as practicable in the operation and construction of shop machines and locomotives in the following order:

Two months on drill presses.
Six months on milling machines and planers.
Nine months on general lathe work.
Three months on air brake work.
Three months in tool department.
Three months in drafting room.
Three months on motion and rod work.
Twelve months on general floor work.

The last few months of the apprenticeship is confined to roundhouse work and running repairs. All boys completing their four year courses receive a certificate showing that his apprenticeship has been successfully completed.

Philadelphia & Reading

The Philadelphia & Reading Railway Co. employ at the present time 55 regular apprentices and 22 special apprentices.

The age limit of both regular and special apprentices is 17 years.

The length of the regular apprentice course is 4 years. The length of the special apprentice course is either 3 years or 4 years, depending whether the boy has graduated from high school or college.

The company has one school room equipped, but has not as yet placed this in use.

There is no bonus offered to complete the course, but practically 100 per cent of the boys complete their apprenticeship.

A complete record is kept of all apprentices.

The following schedules show how the apprentice's time is segregated:

REGULAR APPRENTICES

2 months in miscellaneous gang repairing machines and all kinds of stationary work.
2 months 1" turret (started out by Foreman).
2 months on engine lathe fitting bushings and roughing bolts.
2 months on lathe, doing miscellaneous work on tools and machine repairs.

1 month brass lathe.
2 months fitting spring saddles, putting brass liners on side of trailer boxes, fitting up dry pipes, cylinder cock rigging, and on die work.
1 month lathe in truck rigging gang, fitting bolts and bushings.
1 month on lathe in brake rigging gang, fitting pins and bushings and sawing hub liners.
1 month on planer on driving box shoes and wedges (under direction of machinist on same work).
1 month on 36″ planer.
1 month on frame slotter.
1 month of repairs to air pumps and air equipment.
2 months lathe roughing on rod bolts and fitting pulling bar bushings.
2 months lathe fitting frame bolts, guide blocks and special studs (under direct supervision of machinist).
2 months lathe fitting, extra length frame bolts.
1 month 24″ Colburn boring mill, back end of main rod brasses and rod bushings; supervision.
1 month 24″ Colburn boring mill, boring front end main rod brasses and washers for side rods; supervision.
1 month shaper.
3 months planer—grate bar bearers, on milling machines, slotter and fitting up rod work.
2 months shaper—link work, guides, eccentric keys (under supervision of planer hand).
3 months slotter—handling eccentrics, steam turret boxes, etc.
3 months boring mill—miscellaneous work (under supervision), and milling machine.
2 months laying-out table.
2 months lathe.
2 months on injectors, lubricators and pop valves.

SPECIAL APPRENTICE COURSE FOR HIGH SCHOOL GRADUATES

Machine Shop	6	Months
Air Brake, Injectors, Lubricators	3	"
Boiler Shop	2	"
Smith Shop	2	"
Foundry and Pattern Shop	2	"
Erecting Shop	6	"
Engine House	3	"
Car Shop	6	"
Firing on Road	3	"
Drawing Room	3	"
Misc. Shop Work (Power House, etc.)	3	"
Machine Shop	6	"
Special Duty	3	"
	—	
	48	"

SPECIAL APPRENTICE COURSE FOR COLLEGE GRADUATES

Machine Shop	6	Months
Air Brake, Injectors, Lubricators	3	"
Boiler Shop	2	"
Smith Shop	2	"
Foundry and Pattern Shop	2	"
Erecting Shop	6	"
Engine House	3	"
Car Shop	6	"
Firing on Road	3	"
Drawing Room	3	"
	—	
	36	"

PERSONALS

Thomas R. Cook, chief engineer of the Willard Storage Battery Company, Cleveland, Ohio, was born June 9, 1877, and graduated from the University of Wisconsin in the mechanical engineering course June, 1900. He entered the service of the Pennsylvania Lines west of Pittsburgh at Ft. Wayne, September, 1900, as a special apprentice, and served his time at Ft. Wayne shop, after which he held consecutive positions as follows: From 1900 to 1903, special apprentice; from 1903 to 1904, motive power inspector, Northwest system; from 1904 to 1905, electrical engineer, Northwest system; from 1905 to 1910, assistant engineer motive power; from 1910 to 1912, master mechanic, C. & P. division. In 1912 he was promoted to assistant engineer motive power, which position he held until June 1, 1915, when he took his present position as chief engineer of the Willard Storage Battery Company, as noted above.

E. B. DeVilbiss, who has been appointed assistant engineer of motive power of the Pennsylvania R. R., was born in Ft. Wayne, Ind., September 13, 1884, and after graduating from the Ft. Wayne high school, in 1904, entered Purdue University, from which he graduated in 1908. July 1st, 1908, he entered the service of the Pennsylvania R. R. at Ft. Wayne, as special apprentice. He worked in various capacities in the shop and office until January, 1911, when he was made motive power inspector under Mr. T. W. Demarest at Ft. Wayne, which position he held until his appointment as above mentioned, effective June 1st.

O. P. Reese, who has been appointed assistant engineer motive power of the Pennsylvania Lines west of Pittsburgh, was born May 29, 1876, at Louisville, Ky., and graduated from Purdue University June, 1898. He entered the service of the Louisville & Nashville Ry. August 1, 1898, as apprentice, and January 6, 1900, secured employment with the Pennsylvania Lines West, being assigned to special work, after which he held positions as follows: From 1904 to 1906, motive power inspector; from 1906 to 1908, general foreman; from 1908 to 1910, master mechanic, E. & A. division; from 1910 to 1911, assistant engineer motive power, Northwest system; from 1911 to 1915, master mechanic at Allegheny shops, holding the latter position until appointed assistant engineer motive power, as noted above.

T. G. Armstrong, assistant master car builder, has been promoted to master car builder of the Canadian Pacific Ry., lines west of Fort William, with headquarters at Winnipeg, Man.

B. B. Milner has been appointed engineer of motive power of the New York Central, with headquarters at New York, and is in charge of locomotive design and

construction, and the relation of locomotive standards to operation.

L. B. Jones, assistant engineer motive power of the Pennsylvania R. R., has been transferred from Toledo to Columbus, O., succeeding G. E. Sisco. This change was effective June 1st.

G. E. Sisco, assistant engineer of motive power of the Pennsylvania Lines West, has been appointed master mechanic at Toledo, O., succeeding J. W. Hopkins, transferred.

W. A. Stockbridge has been promoted from motive power inspector to electrical engineer of the Pennsylvania R. R., with headquarters at Ft. Wayne, Ind., succeeding E. B. DeVilbiss.

Geo. H. Wilder, formerly connected with the mechanical engineer's department, has been promoted to engineer of tests of the Chicago, Milwaukee & St. Paul Ry., with headquarters at Milwaukee Shops, Wis. He succeeds W. F. Lynaugh, who resigned to take up work with the Interstate Commerce Commission.

W. M. Bosworth, mechanical engineer of the Louisville & Nashville R. R., has been appointed mechanical engineer of the Norfolk Southern, with office at Berkley, Va.

F. F. Carey has been appointed acting master mechanic of district No. 3 of the Intercolonial Ry., with headquarters at Moncton, N. B.

J. W. Hopkins, master mechanic of the Pennsylvania R. R., has been transferred from Toledo to Mt. Vernon, O., succeeding L. S. Kinnaird.

W. H. Keller, assistant master mechanic of the Baltimore & Ohio Southwestern, at Cincinnati, O., has been appointed master mechanic of the Indiana division, with headquarters at Cincinnati.

L. S. Kinnaird, master mechanic of the Pennsylvania R. R., has been transferred from Mt. Vernon, O., to Logansport, Ind., succeeding F. V. McDonnell.

T. C. Kyle has been appointed master mechanic of the Kansas City, Mexico & Orient Ry., with headquarters at San Angelo, Texas, succeeding W. D. Bennett.

F. V. McDonnell, master mechanic of the Pennsylvania R. R., has been transferred from Logansport, Ind., to Allegheny, Pa., succeeding O. P. Reese.

M. B. McPartland has been appointed master mechanic of the Chicago, Rock Island & Pacific Ry., Nebraska and Colorado divisions, with headquarters at Goodland, Kan., succeeding E. F. Tegtmeyer, resigned.

E. E. Machovec has been appointed division master mechanic of the Atchison, Topeka & Santa Fe Ry., Eastern division, at Argentine, Kan., succeeding D. E. Barton.

W. C. Dean has been appointed traveling engineer of the southern division of the Bangor & Aroostook R. R., succeeding H. P. Roby, appointed to other duties. This appointment was effective June 20th.

Geo. Feetham has been appointed acting roundhouse foreman of the Intercolonial Ry., with headquarters at Moncton, N. B.

Felix Gagnon has been appointed roundhouse foreman of the Intercolonial Ry., with headquarters at Mont Joli, P. Q.

Chas. H. Hauck has been appointed road foreman of engines of the Idaho division of the Union Pacific System, succeeding H. W. Joslyn, assigned to other duties.

D. W. Hay of the Grand Trunk Pacific has been appointed locomotive foreman, with office at Prince George, B. C., succeeding A. H. Mahan.

E. J. Jennings has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific Ry., Kansas division, with headquarters at Herrington, Kan., succeeding T. D. French, assigned to other duties.

W. G. McConachie, road foreman of the Grand Trunk Pacific, has been appointed general locomotive foreman in charge of the territory from Edmonton to Watrous, including intervening branch lines.

A. H. Mahan, locomotive foreman of the Grand Trunk Pacific, has been appointed general locomotive foreman in charge of territory from Prince George to Edmonton, Alta., including intervening branch lines.

J. A. Miller of the Grand Trunk Pacific has been appointed locomotive foreman at Endako, succeeding G. H. Laycock, transferred to Jasper, Alta.

J. F. Moffatt, road foreman of the Grand Trunk Pacific at Wainwright, Alta., has been appointed general locomotive foreman in charge of the territory from Transcona, Man., to Fort William, Ont.

H. E. Brownell

C. W. Reed has been appointed road foreman of equipment of the Colorado division of the Chicago, Rock Island & Pacific Ry., with headquarters at Fairbury, Neb., succeeding D. W. Higgins, assigned to other duties.

H. R. Simpson, road foreman of the Grand Trunk Pacific, has been appointed general locomotive foreman in charge of the territory from Watrous, Sask., to Winnipeg, Man., including intervening branch lines.

Frank E. Wilmore has been appointed assistant road foreman of engines of the Pennsylvania Lines West of Pittsburgh, with headquarters at Ft. Wayne, Ind., succeeding Robert J. Lyons, assigned to other duties at his own request.

P. Alquist, superintendent of the car department of the Missouri, Kansas & Texas at Sedalia, Mo., has been appointed general superintendent of the car department, with office at Denison, Texas.

H. E. Brownell, who has been appointed general foreman of the foundries of the Chicago, Milwaukee & St. Paul Ry., with headquarters at Milwaukee Shops, Wis., was born in 1872. He attended the common schools and at the age of 17 started his foundry career with

the late J. N. Bair in the Milwaukee Car Wheel & Foundry Co., continuing with them after the company was changed to the Northwestern Wheel & Foundry Co. of St. Paul. He has been in the employ of the C., M. & St. P. Ry., in the foundry department, for the past 12 years, and during this time has made a close study of metals and foundry practices. During the last few years he has acted as assistant to Mr. A. W. Bair, and succeeded Mr. Bair at his decease.

Roy W. Bond, superintendent of shops of the Boston & Maine R. R., has been appointed general mechanical shop inspector, with office at Boston, Mass.

H. A. Glick has been appointed air brake instructor of the Bangor & Aroostook R. R., at Derby, Maine, succeeding Mr. Dean.

E. D. Dieffily has been appointed machine shop foreman of the Bangor & Aroostook R. R. at Derby, Maine, succeeding W. R. Farmer, resigned.

W. T. Abbington has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Valley Junction, Ia., succeeding A. R. Ruiter, transferred.

G. W. Cuyler has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Silvis, Ill., succeeding J. M. Kerwin, transferred.

J. J. Fitzgerald has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Trenton, Mo., succeeding W. T. Abbington, transferred.

T. D. French has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Belleville, Kan., succeeding C. B. Reid, deceased.

P. J. Harris has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Estherville, Ia., succeeding G. W. Cuyler, transferred.

J. M. Kerwin has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Cedar Rapids, Ia.

R. McLaren has been appointed general foreman of the Bangor & Aroostook R. R. at Oakfield, Maine, succeeding T. H. Dugan.

A. R. Ruiter has been appointed general foreman of the Chicago, Rock Island & Pacific Ry. at Chicago, succeeding M. B. McPartland, promoted.

A. Watt, general foreman of the Grand Trunk Pacific at Prince Rupert, B. C., has been appointed general locomotive foreman in charge of the territory from Prince Rupert to Prince George.

I. N. Clark has resigned as assistant interchange inspector of the Chicago Car Interchange Bureau to accept the position of traveling car inspector of the Grand Trunk Ry.

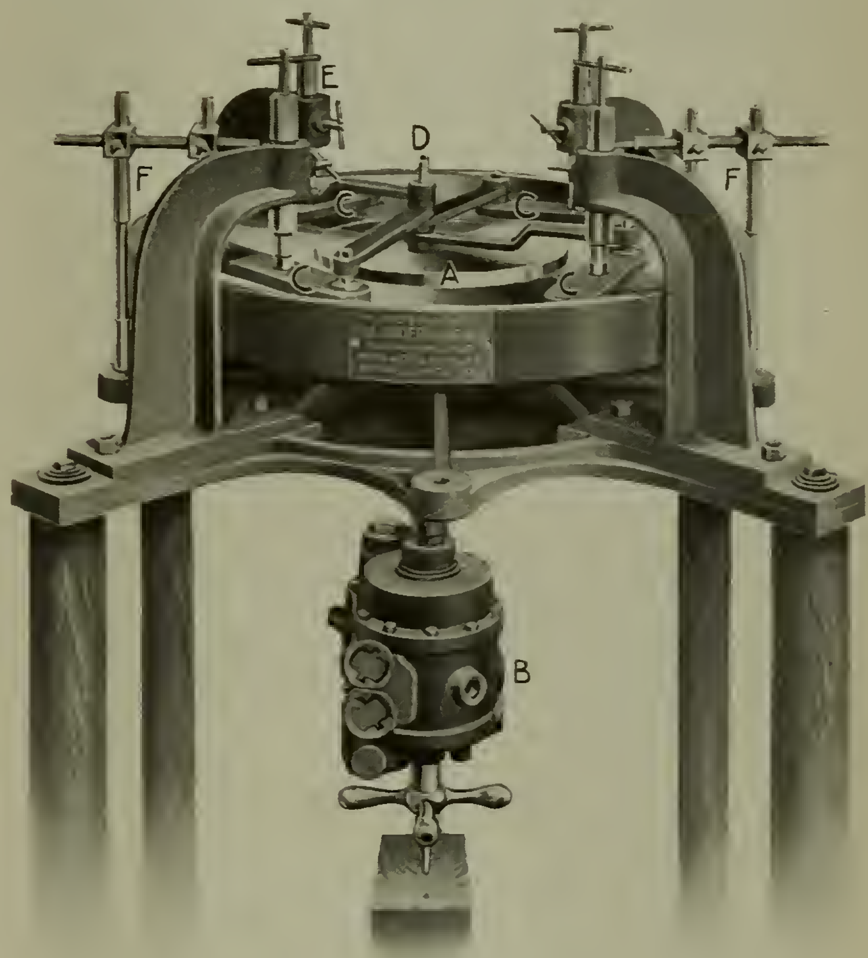
A. G. Kreith has been appointed assistant interchange inspector of the Chicago Car Interchange Bureau, succeeding I. N. Clark. He will be in charge of the Bureau in the "Q" lumber district.

H. G. Love, formerly leading car inspector in the Union Stock Yards district, has been appointed assistant interchange inspector of the Chicago Car Interchange Bureau, succeeding W. C. Sapp, resigned.

According to press reports, the Intercolonial has under consideration the question of building a new superstructure on the bridge over the St. John river at Fredericton, N. B.

REFLEX WATER GLASS GRINDING MACHINE

The illustration herewith is of a Reflex water glass grinding machine, which is being put on the market by H. B. Underwood & Company of Philadelphia. The machine is very simple in construction, with very few wearing parts, and all the wearing parts are protected from coming in contact with the grinding material. The only part which requires attention in use is the removable loose grinding disc which can be redressed or re-



Reflex water glass grinding machine

placed at a small cost. The machine can be operated by unskilled labor and a cheap grade of carborundum—No. 100 mixed thin in black oil has given the best results in service.

The table (A) is revolved by a 100 to 125 r. p. m. air motor. There are 4 glass holders (C) which are given an oscillating motion by pin (D) set eccentric with the table. This arrangement prevents the glass from running in a concentric groove and avoids scratching or cutting the glass in ridges. The glasses are held under a flexible pressure which can be regulated to the required amount by the pressure device (E). The grinding compound is kept in contact with the glasses by 2 spreaders (F) placed opposite each other.

The Erie Railroad has applied to the New Jersey commission for a rehearing on the case of eliminating grade crossings in Paterson, N. J., to cost about $3,000,000. The company is willing to proceed with construction if substitute plans, making cost about $1,000,000, are accepted by that city.

The freight sheds of the Grand Trunk Ry., on the St. Clair River front at Port Huron, Mich., were burned July 5. The estimated loss, according to press reports, is $300,000.

The War Department has granted permission for the construction of a bridge over the Bronx river at Westchester avenue in the borough of the Bronx, New York. The bridge is to be built to carry the tracks of the Pelham Bay Park branch of the Lexington avenue subway, which at this point runs on an elevated structure. The plans call for a permanent bridge with a clearance of 61 feet above mean high water.

The New York, Chicago & St. Louis R. R., according to press reports, will start at once on the elimination of grade crossings between Detroit avenue and Fulton road, Cleveland, Ohio. The total cost will be about $2,000,000. Of this amount the city pays 35 per cent. The city's funds will be used first because of the railroad's difficulty in financing at this time its portion of the cost.

The city engineer of Portland, Ore., is preparing plans for the construction of the Union Avenue viaduct over the tracks of the Oregon-Washington R. R. & Navigatin Co. The estimated cost is $50,000.

The Oregon-Washington Railroad & Navigation Company will build a 12-stall roundhouse, a 40-ft. by 60-ft. storehouse, a 30-ft. by 40-ft. powerhouse, and a 50-ft. by 60-ft. machine shop at the Dalles, Ore. The powerhouse, machine shop and roundhouse will be brick buildings with mill interior, and the storehouse will be a corrugated, galvanized building on wood frame.

A contract has been given by the Pennsylvania Railroad to the Bailey & Lush Company, Philadelphia, at $150,000 for building a double-deck stock pen on Herr's Island, Pa.

The Pennsylvania Railroad has given a contract to the James McGraw Co., Philadelphia, Pa., for building the concrete arch bridge at Campbell's Crossing, Phœnixville, Pa., west of Frick's lock. The bridge is to consist of seven 84-ft. concrete arches for double track.

The Pennsylvania Railroad will ask for bids soon for installing some of the new coal handling facilities to be provided at Canton, Baltimore, which are expected to increase the tonnage of coal exported through Baltimore. The improvements include a concrete bulkhead pier, machinery for loading coal into vessels, a coal dumper, thawing house and extensive freight yards for loaded and empty cars. The new pier is to be 942 ft. long and 66 ft. wide, and the coal handling machinery on the new pier will be capable of loading at least 6,000 tons of coal in ten hours. The thawing house will have a capacity of 30 cars, and there will be a tributary yard with a capacity of 79 cars. The loaded car yard is to have 36 tracks with a capacity of 620 cars, and the empty car yard is to have a capacity of 139 cars, with shop car tracks to hold 28 cars additional.

Bids are being asked by J. W. Pugsley, secretary, Department of Railways and Canals, Ottawa, Ont., for improvements on the main line of the Intercolonial Railway as follows: Construction of abutments and piers at St. Henri river bridge, Riviere du Loup subdivision, and subways at Little Metis, Campbellton subdivision, and at Hampton, St. John subdivision.

The St. Louis, Iron Mountain & Southern contemplates building a new depot at Claremore, Okla. No definite decision has yet been reached as to the size of the building, or when it will be constructed.

The Southern Railway is asking for bids for work on a modern freight terminal, to include separate inbound and outbound warehouses with ample team track facilities at Spartanburg, N. C. The work is to be started at once, and the improvements will cost about $100,000. The new facilities will consist of a one-story inbound freight house, 40 ft. by 198 ft., with a two-story office section 40 ft. by 52 ft., to be of brick construction with concrete floor, fireproof roof, and equipped with rolling steel doors; the outbound freight house will be a one-story structure 22 ft. by 250 ft., with concrete floor and base, frame construction and fireproof roof. There are to be four house tracks, with a capacity of 32 cars, and four team tracks with a capacity of 29 cars. A 20-ton Pillar crane will also be provided for handling heavy freight.

NEW LITERATURE

The R. D. Nuttall Company, Pittsburgh, Pa., has issued Catalog No. 13, covering electric railway gears, pinions and trolleys. This publication gives general data on Nuttall railway motor gearing for Westinghouse and General Electric equipments, Nuttall trolleys, harps and wheels, flexible couplings of the spring and buffer type, and electric railway compressor gears.

The Ingersoll-Rand Company, 11 Broadway, New York City, has recently issued two new catalogs, form 3031 and 4034. The former is descriptive of the new "Ingersoll-Rogler" class "FR-1" steam driven single stage straight line air compressor. The catalog is profusely illustrated, showing the details of the machine in section. Among the principal features of construction may be mentioned the "Ingersoll-Rogler" air valves in the air cylinder and the balanced piston steam valve with automatic cut-off control in the steam cylinder. The air valves are silent in operation and long lived, operate entirely independently of any driving mechanism, and require practically no attention. The steam valve represents the most approved design, permitting the use of the highest steam pressures and superheated steam. Form 4034 covers the type No. 26 Leyner-Ingersoll water drill. This drill resembles the large successful Leyner-Ingersoll drill No. 18, but is considerably lighter in weight and intended for smaller diameter and shorter depth holes.

DECISION IN CAR HEATING PATENT SUITS

In the suit of the Safety Car Heating and Lighting Co. vs. United States Light & Heating Co. the Circuit Court of Appeals has handed down a decision affirming the decision of Judge Hazel of the Western district of New York. Judge Hazel held that the first eight claims of Creveling patent No. 747,686, owned by the Safety Car Heating and Lighting Co. (which were the only claims involved in the suit) were valid, were entitled to a broad interpretation, and were infringed by both the taper charge and stop charge systems of the United States Light & Heating Co., the defendants. There is no appeal from the decision of the Circuit Court of Appeals.

A decision was also rendered in which patent claims 4, 9, 10, 11, 12 and 13 of H. G. Thompson patent No. 1,070,080, owned by the Safety Car Heating and Lighting Co., were alleged to be infringed by the Simplex System of the Gould Coupler Co. This decision was made by Judge Hazel in the United States Court for the Western district of New York.

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TO OUR READERS.

Someone has wisely said, paradoxical though it may seem, that *"Nothing is constant but change."* The history of everything is only a series of changes. From the beginning of the universe changes have been constantly taking place, and, as we all know, each period in geology has outdone its predecessor in advancement, resulting finally in the introduction of the human race, which has brought about change after change, until we now enjoy an era of wonders—inventions—and a condition of progress and universal prosperity.

Following the rule thus laid down, this issue of the RAILWAY MASTER MECHANIC appears under new management and is sent forth from a new home and new surroundings, with the hope of its owners and those engaged in its production that this change, too, will be for the better.

The periodical was born and brought up in Chicago, and by reason of this has been educated to a standard of general usefulness, and on lines of present-day progress.

It is with no disparagement, therefore, to its past that we hope to improve its standing in the world; but rather with the notion that every change makes for the better, on general principles.

Established in 1878, the MASTER MECHANIC all these years has aimed to satisfy a demand for information and further education in a field which to-day is one of the most important branches of the railroad business. It has found its way into every railroad machine shop and every railroad office in the land. It has stood for honesty of purpose, and on the side of the railroads and their employees in their more than strenuous efforts to serve the great American public, and it will hold to this policy in the future.

The MASTER MECHANIC will also continue to wear its old dress; but, like the man of prominence in affairs who was once criticized for his lack of style, it can well say, "Everybody knows *me,* and I occupy a position where I can at least dress as I please."

The MASTER MECHANIC has pleasantly fallen into the hands of the Railway Periodicals Company, a New York corporation, and from its New York headquarters, with a new editorial staff and new executives, will continue, with an extra effort, to meet the requirements of its readers.

It invites patronage; it will be pleased to consider every suggestion which its patrons may offer looking toward its improvement, and will deal with such current events in the railroad world as will especially interest those who are in the habit of turning its pages.

Ernest C. Brown is president of the Railway Periodicals Co., Inc.. which owns and has assumed the direction of the RAILWAY MASTER MECHANIC, the *Railway Engineering and Maintenace of Way,* periodicals, as well as the *Monthly Official Railway List.*

The office of publication has been removed from Chicago to Vanderbilt Concourse Building, 52 Vanderbilt Avenue, at East 45th Street, nineteenth floor, New York. The transfer of ownership is so recent that little opportunity has been allowed to gather all the talent necessary to produce a publication fully up to the ambition or intentions of its owners, but that will come in due season.

Mr. Brown is a successful publisher of over a quarter of a century's experience in directing the affairs of technical publications. He owns a large majority of the shares of the Railway Periodicals Company, and has acquired these publications as an investment, acting on the belief that the railway interests of the country are on the threshhold of greatly improved conditions, which these periodicals, in their sphere, can aid by stimulating and putting them forward. A staff, to which other trained hands and minds will be added as the trend of affairs requires, has been brought together.

The brief resumé of the careers of some of the gentlemen already connected with these periodicals will indicate our intention to publish timely, useful and practical matter, which we feel safe in saying will prove of increasing worth to our readers, whose active co-operation and friendly encouragement is most earnestly sought.

S. A. Bates, the Secretary and Treasurer of the new company, has been connected with the publishing business in an executive capacity for about five years. His experience in the active administration of large interests covers more than twenty-five years. His knowledge of business development will enable him to handle the affairs of the company which will be in his charge so that our patrons will obtain service and satisfaction.

Charles Samuel Myers, vice-president and business manager of the new company, has long been associated with these publications. He began his career in the business department of the Chicago *Daily Mail,* where he handled railway and financial subjects. In 1899 he became associated with the RAILWAY MASTER MECHANIC, *Railway Engineering and Maintenance of Way,* and *The Monthly Official Railway List,* in the business department. Since that time he has been actively engaged in furthering these various interests. Mr. Myers has been the mainstay of the publications during the recent period of reorganization and now throws himself into the work before him with renewed enthusiasm.

Benjamin Norton, editor-in-chief, is a graduate of Williams College. After studying law and being admitted to the bar of New York State, he took up railroad business as a profession, beginning at the bottom, on the Manhattan Beach Railway in its early days. Later he filled a position as clerk in the local freight office at Indianapolis of the I., B. & W. Railway, now the P. & E. division of the "Big Four." Afterward he came to the Long Island, occupying various positions, until he was made purchasing agent and paymaster of the road. He became assistant superintendent following this, and for five years, later on, was vice-president and general manager.

He was elected president and General manager of the Atlantic Avenue system of electric lines, in Brooklyn, following his services on the Long Island, and remained in that position until the system was absorbed by the Brooklyn Rapid Transit Co. He built and operated the Orange County, N. Y., traction lines; was afterward general manager of the Ohio Southern, representing the first mortgage bondholders, to whom the road fell after a long receivership. He was finally elected president and general manager of the Toledo, St. Louis & Western, known generally as the "Clover Leaf." There he remained for about five years, or until other interests came into control. Since then Mr. Norton has been engaged in the examination of railroads for various banking interests, and has found time to indulge in literary work in a general way. His long experience, covering more than twenty-five years of active and practical railroad work, is a guarantee of his familiarity with the needs of this periodical.

George Sherwood Hodgins, A.S.M.E., takes the position of managing editor of the publications. He is not unknown in the field of technical journalism. Mr. Hodgins was born in Canada, and received his technical education at the School of Practical Science in affiliation with the University of Toronto. Leaving the educational institution and passing through the apprentice stage in a locomotive building establishment, he began practical railway work in a division master mechanic's office on the Canadian Pacific Railway. On that road he held a number of positions as advancement came, and had become locomotive inspector for the entire system when another position opened for him—as mechanical engineer of the locomotive works in which he had served his apprenticeship.

When hard times came to that concern, he took service with the Pressed Steel Car Co., of Pittsburgh, and had the inspection of the output of that important and extensive plant placed in his hands. While in Pittsburgh, a New York railroad publication, to which he had been an occasional contributor, secured his services as editor. He has been a close student of railway problems, both mechanical and economic, and has also contributed in his spare time to the pages of popular science magazines.

He has thus had a wide and practical railroad experience and has done editorial work in New York for eight or ten years. Two years ago he was called upon by the Canadian government, as an outsider, yet familiar with Canadian conditions, to make a comprehensive report on the shops, appliances, tools and equipment of the National Transcontinental Railway, before final negotiations were entered into with the Grand Trunk Pacific Railway. Having completed that work, Mr. Hodgins has now joined the staff of the RAILWAY MASTER MECHANIC.

Laurence A. Horswell, after his technical training in the University of Wisconsin, has for four years been writing for railroad men on their own and railroad supply subjects. He has been engaged in a number of practical investigations where the applicability and utility of railways appliances were undergoing the service test. After this experience he became associate editor of the RAILWAY MASTER MECHANIC and also *Railway Engineering and Maintenance of Way,* and with his camera has been visiting a number of railroad shops gathering editorial material. This and similar work from his pen will appear in the columns of the periodicals, and in his investigations along these lines we bespeak for Mr. Horswell a cordial reception from those with whom he will come in contact and those whose interests we desire to serve.

THE LONG ISLAND RAILROAD SHOPS

The article on the Long Island Railroad shops at Morris Park, which appears in this issue, brings back pleasant recollections to one, who was for many years connected with the management of that road. The shops were erected during his time. Austin Corbin, who was then president of the company, saw early in his regime

the necessity for suitable repair shops, but was not himself of a mechanical turn of mind. He remarked to Anthony Jones, the engineer in charge of construction, that absolutely first class shops should be built; all he wanted to insist upon, however, was that the main chimney must be a model of architectural beauty, high enough for its purpose but as shapely as human ingenuity could plan it. He said that he would consider it a monument to himself if so built. It stands to-day, a model smoke stack and lords it over the surrounding country as it did in Mr. Corbin's time, serving its purpose, too, as a chimney and incidentally as a substantial monument to the former president of the road. Visitors at the shops have often remarked that its design is perfect. Many changes have come since those days. Mr. Corbin has long ago gone to his rest, but besides being the promotor of the railroad shops he was the great instrument by which the entire property was brought out of a slough of despond and placed upon a sound basis. His dream of tunnels under the East River and in time an electrically operated system are coming true. It was his misfortune to have lived twenty years ahead of his time.

MR. F. F. GAINES' CONVENTION ADDRESS

The President of the American Railway Master Mechanics' Association, Mr. F. F. Gaines, delivered the opening address at the forty-eighth annual convention of that association this year. Mr. Gaines, who is Superintendent of Motive Power of the Central of Georgia Railway at Savannah, Ga., spoke in what may be called a practical business way of the work of the association in the past and what lay before it in the future.

He touched briefly on a topic which, for a number of years, has been steadily gaining the appreciative attention of the members. With reference to the consolidation of the Master Mechanics' and the Master Car Builders' Associations, he believed the time had come to effect the union in which, while a central or supreme authority would be vested in one Railway Mechanical Association, yet the various departments such as the locomotive, the car, the electrical and other branches of railway mechanical work would be handled by separate sections.

The speaker did not expect any great saving of time under such an arrangement, in fact he disregarded the argument of time saving altogether, but based his views for consolidation largely on the fact that there should be one recognized authority on matters mechanical, pertaining to railway work. Practically all the members of the M. M. and the M. C. B. Associations come under the jurisdiction of the mechanical department, and that as railway practice regards the care of locomotives and cars, as branches of mechanical department activity, we might very well do the same.

Coming to the subject of standards, the president referred to the largely educational work done in the past by the Master Mechanics' Association. While he considered this work good, he regarded it as important that we should have definite standards for such things as were capable of being standardized, in the way of methods and specifications. He urged the committee on specifications not to be too rigid in drawing up the requirements for material. The object to be sought was to obtain a fair grade of material for the service required from it, but at the same time to avoid a greatly increased cost which would result in the majority of railroads not making use of the specification. He considered that after we had gone more fully into the matter a committee should be appointed to confer with the American Railway Association on the subject. He suggested that the existing committee on relations between railways and legislation might endeavor to get the American Railway Association to lend its efforts toward the adoption by the railroads of such standards and specifications as the Master Mechanics' Association or its successor might bring forward.

Mr. Gaines next said a word with regard to the necessity of "speeding up" the work of the various committees. Many times it would, he believed, add to the value of the proceedings and information of the members if the reports were in the hands of the secretary and printed in ample time to allow the gathering of data, and of investigating practices, so as to be able to discuss them to greater advantage. Mr. Gaines attached importance to the intelligent discussion of the reports as being a material contribution to the value of the proceedings.

The president spoke of the advantage of securing the assistance of associate members on committees. Some of these men had more time at their disposal than many actively employed railroad officers. Associate members had the necessary technical training and are familiar with committee work. Just here Mr. Gaines suggested that the incoming executive committee might see that the reports were indexed on the margin for ready reference. that the logical handling of the subject be followed through consecutively and that the report, in general, be made as clear and concise as possible.

We have now, in a sense, representative membership in the Master Mechanics' Association. This should be encouraged, and those roads which have not taken out representative membership should be urged to do so.

Judging from the reports, said Mr. Gaines, we do not seem to be giving a thorough training to our inspectors. whose duty it is to look after the working of the Federal boiler law, safety appliances, and other Interstate Commerce Commission regulations. It has been recommended that railroads pay more attention to the education of road foremen of engines, enginemen and firemen, and provide a more through examination for firemen, before promotion to enginemen is made.

The University of Illinois has a fully equipped testing plant, capable of dealing with the heaviest locomotives. and it has been suggested that the results of tests of locomotives made at this institution be supplied to members of our association, and that the railroads bear a proportional cost. A test so made and paid for would be less expensive than if the test was made for a single road. On account of the tested locomotive being under cover and not subjected to variations of temperature or other

disturbing circumstances, would have the effect of making conditions practically uniform for all tests.

In dealing with locomotives, the president said that attention should be given to developing and refining the present types of locomotives in the matter of economy in performance, rather than to size and weight. He considered that while the association very rightly discusses engineering questions relating to locomotive practice, it does not go very deeply into the discussion of whether or no the investment represented by new equipment or appliances brings in adequate returns. He here asked the pertinent question, do we sufficiently investigate the question of what becomes of the dollars that we spend on these items? Very little is heard of cost. It might be well to give consideration to the cost of doing various classes of standard work so that those of us who are working inefficiently may see what improvements can be made. Every member of this association should put himself in the attitude of a business man toward a dollar. As a suggestion, a partial list might be: Cost of small tools, cost of power in power-houses, costs of oxy-acetylene and electric welding, cost of tube work, cost of turning locomotives, costs of staybolt renewals, repairs to springs, turning driving wheels and fitting up driving boxes, shoes and wedges. If accurate figures could be obtained for these items we could more intelligently work for the reduction of cost.

Do we know when a new engine of a new type, is put into service whether or not its increased weight, capacity and cost are justified? Do we know when a new and improved tool is purchased and put in service in the shop, whether or not the expenditure for the tool is justified by the output?

The theoretical advantages of the superheater are well known, the practical saving in cost that can be accomplished by its use is well known, but do we know that we are getting anything like this in every day service? Do we keep constantly reminding our round-house foremen to see that tubes are always clean, joints kept tight, and that most economical handling of locomotives is being carried out? If we do these things, do we keep the operating department informed of them? Do we inform that department as to the results of improved devices or designs? Do we give information as to costs to our subordinates in such form that they may analyze them and endeavor to make improvements wherever they can be made?

These are some of the very important matters which Mr. Gaines brought to the attention of the Master Mechanics' Association in concluding his business-like and suggestive address. The columns of the Railway Master Mechanic are open to all for the discussion of these and kindred topics.

FAILURE OF SYSTEM OR MAN.

In the investigation of accidents, one essential is generally left out. The operating staff are called upon to tell all they know and explain how it all happened. They are lined up and interrogated. One or more of the men are usually adjudged guilty. The public accepts the verdict and the matter is closed.

In investigations of this kind the men have probably told the truth and the investigators have been fair-minded and honest. Yet from the nature of the proceedings they do not always reach the bottom of the case, simply because they may not suspect the importance of a certain obscure factor. They may be perfectly right about the facts, but they do not fully understand how the facts came to be as they really are. Counting the ripples on the surface of a pond may give a certain idea of the extent and power of the cause, but it gives no hint that stones, and not watches, were thrown into the water and are the occasion of the disturbance.

Every one admits that the human being is fallible. Many mechanical safeguards have been applied, because a man cannot be relied upon to fail always on the safe side. The railway signal system is designed and operated so that in the event of derangement, the signals will go to "danger," and thus fail on the side of safety. They may produce delay, but they will not work disaster. The "dead-man's handle" requires a pressure from the man who drives. The withdrawal of his hand, or the slackening of his grasp, cuts off the current and applies the brake. It, like the signal, operates on the side of safety, when the man fails.

The human machine cannot be fitted with such a safeguard that will bring the results of his action all on one side. Failure in men does not insure safety. In an emergency,—in the course of work outside routine, the man uses his faculties, and we judge him by the result of his actions and take no account of the condition his faculties were in.

As an example, suppose a man passes a "danger" signal and a rear collision results. He is judged solely by the effect of his act. He is proved to have passed the signal. This fact is true. The man is blamed, and rightly, so far as the facts show. He may protest that the signal when he saw it showed "clear." It was a case like this which made a noted railroad president exclaim after an accident, "He had the best record on the road and when men like he can fail, I do not know what to think." It is undoubtedly and plainly true that men have acted in contravention of rules, expediency and duty, and did so believing they were right.

An instance, given by a doctor, showed that a gang of men in a coal mine pushed a loaded lorry over the edge of a gallery, and sent it crashing to the bottom of an open shaft in the full belief that the hoist to take the load had been hauled up to their level and stood opposite the track upon which they worked, and what was more, they stated solemnly that they had seen the hoist. They believed they had.

A captain on one of the trans-Atlantic passenger steamers entering New York told some friends, that after a few nights of anxious watching on the bridge he saw a schooner, one of the kind which he feared he might encounter in an awkward place in the narrow channel he had to follow. He was about to alter his

ship's course when checked by the first officer. In a moment more the captain realized that there was no schooner there. He had seen one because his thoughts were dominated with the idea. He looked for it, and behold it was there.

So eminent an authority as the late William James, professor of psychology at Harvard, speaking of a similar happening in his own experience, says, "I remember one night in Boston, whilst waiting for a 'Mount Auburn' car to bring me to Cambridge, reading most distinctly that name on the signboard of a car on which (as I afterwards learned) 'North Avenue' was painted. The illusion was so vivid that I could hardly believe my eyes had deceived me."

There is always a possibility, nay, a danger, of a man seeing what he *expects* to see, and acting on the result of this perverted sight, with none to know his mental bias and none beside to aid. Wreck and disaster only wake the man to the knowledge that he has failed.

Our exaltation of pure fact is derived from the law courts, and it is a question if we have not partly outgrown this form of procedure and must fit our investigations more closely to find out what we want to know.

We hold no brief for either side, yet an investigation is often reviewed, and men and facts re-examined. Operating rules are scrutinized, sight, hearing and touch are evaluated, but the resulting group of facts is interpreted, with the personal equation left out. We do not depreciate the value of these investigations. They are most necessary. We only hope to see in time an extension of their scope and aim. Human failure is and must be, at base, psychological, and a trained man capable of getting at or seeing such facts might with propriety sit upon any investigating board. His work would be of benefit in two ways. He would present his facts and so round out the "finding" with the basic element of a deeper truth. A series of such investigations would at length be likely to point to some vital spot or weakness in a method of operation to a condition or even to a tendency. Later a remedy could be thought out and applied. The net gain to the science of transportation would be beyond price.

The failure of a man has its pathetic side. He finds himself confronted with what, to him, is an emergency. He stands there momentarily irresponsible, yet acts! The succeeding moments find him normal again, when it is too late, and his hitherto unbroken record of excellence extending over years, is shattered for the moment, but at once regained mentally, for years to come, if he could blot out the consequences of his fall.

Human failure is erratic, uncontrolled by precedent, and cannot be depended on to insure delay, not accident. Is it not our duty, as we take up the task of investigating facts and the actions of men, to see to it that our instruments of perception and interpretation are fully adequate for the work, and that they are applied with the skill and caution. There is a psychological side to it all that is worthy of some consideration.

SEEKING THE CONFIDENCE OF THE PEOPLE

In any democracy it is not only highly important that those who exercise the franchise shall be intelligent, but a further requisite is forcing itself on the attention of the public and the railroads. This second phase of the situation is that it is necessary to keep the public properly informed. This has been a lesson which both the railroads and the man in the street is now learning after some trying experiences.

The railroads have not always been right, and the public has not always judged with full knowledge. The result in the past has been that severe legislative enactments have, while tending to equalize competition, had the further effect of reducing efforts at expansion by the railroads, and their purchasing power being thus restricted they have not spent the money that was expected, and manufacturers have suffered in consequence and railroad supply firms have felt the pinch of hard times.

In order to undertake the work of informing and educating the public, the committee of the associated railroads of Pennsylvania and New Jersey, which conducted the campaign in those States for the repeal of the "Full Crew" law, have proposed the formation of a permanent organization to be known as the "Department of Public Policy and Relations," with branch or subsidiary organizations on each of the railroads interested, as they all are.

The promoters of this movement are careful to point out that the work of such an organization, if formed, should not become active in political affairs but should devote its energies to so wide and so full a presentation of their legitimate interests as will successfully forestall hostile or even injurious legislation, and will promote, without partisan motives or actions, the passage of laws that will secure benefits to themselves without in any way encroaching upon the rights of the public.

The committee frankly acknowledge their desire to take a leaf out of their own employee's book in the matter of legislation, and point to the recent creation by four railroad brotherhood organizations of a "Joint National Legislative Board" to represent the employees in dealing with legislative matters. The committee might also have indicated another influential organization, the Railway Business Association. This body has by a policy of publicity conducted with skill and discernment, and with an entire absence of heat, opened the eyes of many who needed to have their sight directed to a definite objective. Showing the possible prejudicial consequences of acts of the legislatures in various States which while seemingly were for the general good, has had a wisely deterrent influence on hasty legislation.

It is this policy, if adopted by the railroads—that of taking the public into their confidence—which will, when requests are to be made, or when more or less drastic measures might throttle initiative and restrict growth, ensure that real progress can be had. Under this policy false steps will not so readily be made, only to be retraced, and experimentalism in legal enactments can be abandoned. The policy they inaugurate must aim to secure the nation's complete confidence.

Change of Ownership

The three publications known as the "Railway Master Mechanic," "Railway Engineering and Maintenance of Way" and "The Monthly Official Railway List," have been sold and delivered to Mr. Ernest C. Brown, 280 Broadway, New York City.

The Bill of Sale includes the good-will, advertising, and subscription contracts, mailing lists, cuts, electrotypes, editorial matter, books of account, and all of the accounts receivable due from advertising and subscriptions. All advertising and subscription bills are collectable by the new publisher, to whom all remittances should be made.

This is effective as of July 19th, 1915.

Formerly publisher of

RAILWAY MASTER MECHANIC,
RAILWAY ENGINEERING AND MAINTENANCE OF WAY,
THE MONTHLY OFFICIAL RAILWAY LIST.

Chicago, Illinois, July 19, 1915.

280 BROADWAY, NEW YORK
August, 9, 1915

To Our Patrons

The foregoing notice of "Change of Ownership" is self-explanatory. I have acquired the periodicals named therein and the office of publication has been removed to New York, from whence the August and future issues will be published.

I have laid definite lines along which these papers are to be developed and it is my hope and belief that our advertisers and subscribers will soon recognize the distinctive character, advanced policies and general timeliness which the periodicals will take on, and will continue the good will which they have heretofore extended to these publications.

I shall endeavor to deserve your consideration, but the papers will soon speak for themselves. I am now forming a corporation under the laws of the State of New York, to be known as the Railway Periodicals Company, Inc., to hold the ownership, all of the stock of which, save a few shares to be allotted to the officers and the employees of the proposed corporation, will be owned and retained by me.

Mr. Charles S. Myers, who has for many years been associated with the publications and is well known to their patrons, will continue as Vice-President and Business Manager.

I am bringing together a staff of experienced and skilled editorial writers—men who have had, through actual service, extensive practical knowledge of the technique of railroad construction and operation.

In the future kindly address all communications and make your remittances to the order of the Railway Periodicals Company, Inc.

Earnestly soliciting the continuance of your patronage, I beg to remain,

Very truly yours,

ERNEST C. BROWN.

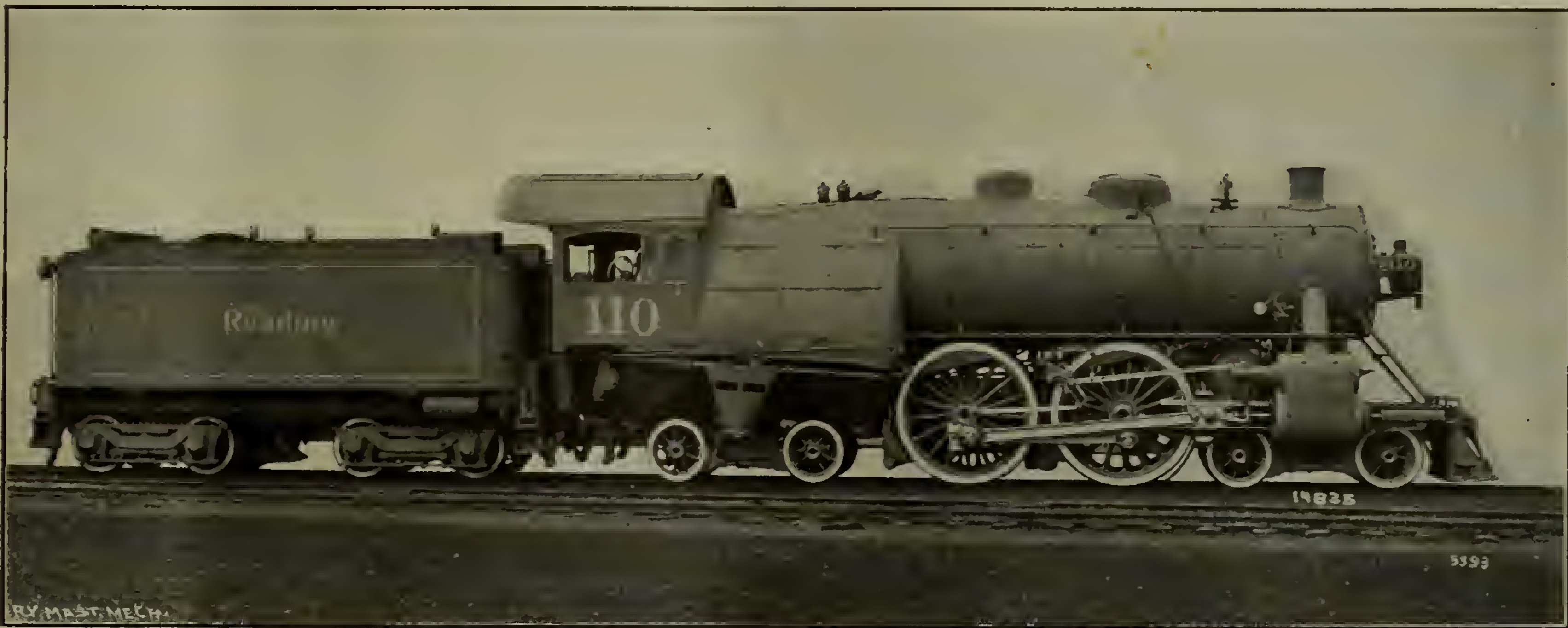
New 4-4-4 "Reading" Type Loconotive

The striking feature of the new 4-4-4, heavy passenger locomotive recently built in the shops of the Philadelphia and Reading Railway is the fact that the two ordinary carrying wheels under the firebox, have been replaced by a 4-wheel truck similar to and interchangeable with the engine truck. This feature of the design, although it brings another pair of journals into service, has the advantage, from a round-house point of view, that a special size of carrying wheels is not necessary, as the leading and trailing trucks are both equipped with 36-in. wheels. The substitution of one truck for another, or the borrowing of a truck from another engine, may be a matter of convenience to those who have to handle the engine at terminals. An exceedingly troublesome "hot-box" on a truck; and a short terminal stay, may be satisfactorily handled by this arrangement.

In order to place the trailing truck, the main frames stop at the firebox, and a substantial steel casting serves to securely unite them. To the centre of this casting the back frame is fastened. The back frame is made of two rolled plates 1 inch thick and 30 ins. high. They have horizontal flanges at the bottom, and their upper ends are sloped up to a roof-like shape and electrically welded at the top. The centrally placed back frame has its sides tied with a number of 10-in. channel spacers, and is practically something like the centre sills of a steel car.

The rear frame, like back end of the front one, terminates in a heavy steel casting to which the draw casting is attached. At the centre of the rear frame a centre plate is placed for the rear truck. The ash pan is divided into three portions. The centre division opens outside the track, the front and rear discharge between the rails. Notwithstanding that the boiler is large and the firebox extensive, in order to burn hard coal, a regular cab has been provided by which both the enginemen are together. The curve of the firebox, however, is so large that the sides of the cab come flush with the outside of the box, and there is no running board along the firebox.

The firebox is, of course, of the Wootten type with combustion chamber, and the box itself measures 12 x 9 ft. or 108 sq. ft. area. Two firehole doors 10 x 18 ins. provide means for feeding the fire. The boiler barrel tapers from 82 ins. to 72 ins. at the front end, and is altogether the largest boiler in passenger service on the P. & R. There are 225 tubes 2 ins. in diameter, and there are 32 superheater flues 5⅜ ins. diameter. The total heating surface, including firebox, combustion chamber, flues and tubes is 2491 sq. ft. An idea of what this total area amounts to may be had by anyone familiar with the baseball field. This engine has an area exposed to the flame and the heated gases of combustion something larger than one-quarter of the baseball field. A jet of steam from the exhaust cavity of the cylinders and from the air pump can be turned into the ash pan when desired, and this tends to prevent the formation of clinkers when burning low grade anthracite coal.



Fast Passenger 4-4-4 Type Locomotive, Philadelphia & Reading Railway.

S. G. Thomson, S. M. P. & R. E. Builders P. & R. Railway.

The weight of the engine, which is 230,800 lbs., is distributed so that 28,800 lbs. is carried on the leading truck; 55,800 lbs. is on the trailing truck, which gives the four driving wheels 146,200 lbs. This means an axle load of 73,100 lbs. or a wheel load of 36,550 lbs. There are other locomotives on the P. & R. with greater total weight, but the weight on the drivers of this engine is greater in proportion. The driving and truck axles are hollow and are heat-treated. There has been a very marked effort in the direction of reducing weight of parts. Chrome-nickel heat-treated steel has been used for the driving and engine truck axles, and the hollow centre has facilitated the beneficial action of the heat-treatment. The driving axles have 6-in. holes and the truck axles 3½ ins. Piston-rod extension guides are chrome-nickel steel, heat-treated. So are the main and side rods, the crosshead guides, the pistons and piston-rods, the cross-head centres and the valve motion parts. Other small parts are made of the same material, where strength and a minimum of weight are required.

The metal aluminum forms the cross-head shoes, the main steam valves, smoke-box door clips, the cross-head for piston-rod extension, the wheel for hand reversing gear, valve stem crosshead, and the cab window frames. The cross-head guides, and those for the piston-rod extension cross-heads are V-shaped. They are made of bent plates of heat-treated steel. The construction here adopted permits a comparatively small cross-head to

be used, yet having ample bearing surface. The cross-head centre is made of heat-treated steel, and has the usual piston-rod socket and key. A hole for the wrist-pin is provided, and the centre is shod with aluminum liners which have babbitt-bearing surfaces. The pistons are made of heat-treated steel discs. They are conical in shape, and it is said that they are the lightest pistons used in heavy service under high pressure. The piston-web is 5/16 in. thick, where it joins the rim, and 1½ in. thick where it joins the centre. All the reciprocating parts are light, which has the effect of facilitating counterbalancing and permits great weight to be applied to the drivers. The calculated tractive effort of this engine is 36,600 lbs., the cylinders being 23½ ins. diameter and 26 ins. stroke and the driving wheels are 80 ins. in diameter. The steam pressure carried is 240 lbs. to the square inch.

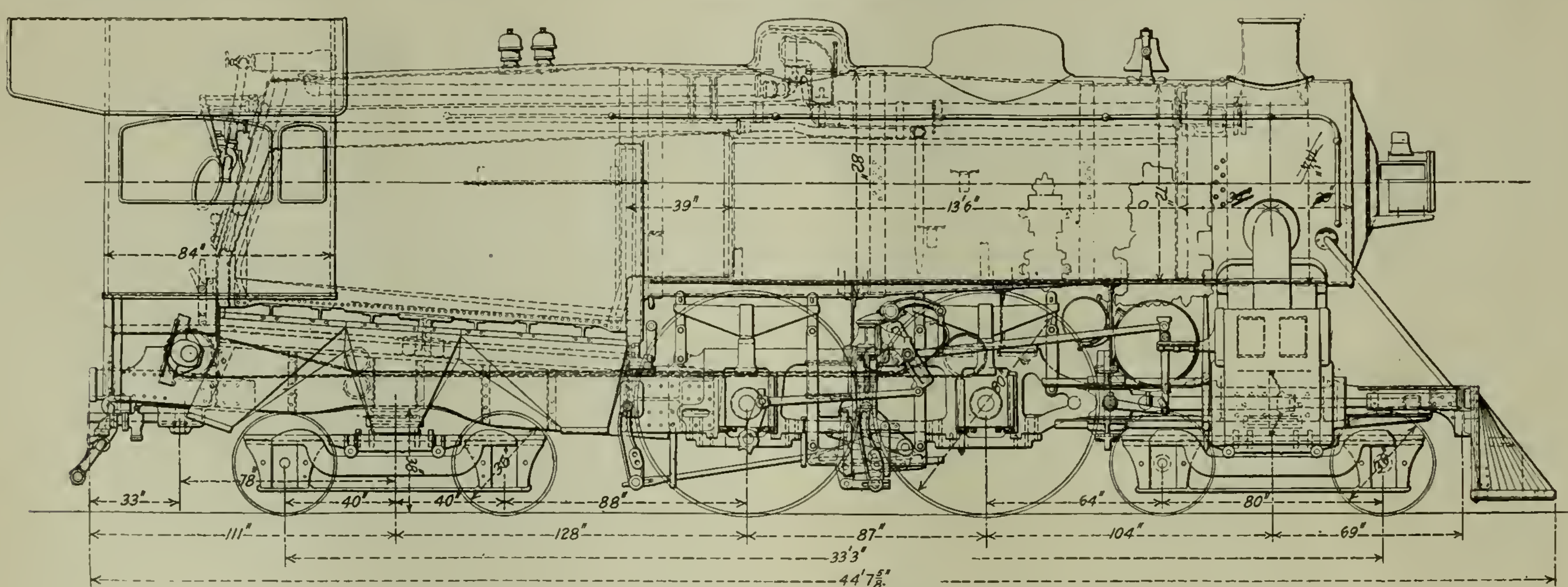
The reversing mechanism is different to that usually employed. In this case it is a cable made of 7/16 in. steel. The cable is fastened to a drum below the cab deck. This drum is operated by an aluminum hand wheel. The cable is carried forward through the duct formed between the plates of the back frame and reaches a lever in the form of a sector on the centre of the tumbling shaft. A counterbalance weight is provided to overcome the resistance of the parts to be lifted. The whole apparatus is lighter than the usual reverse lever and reach rod, and moves the valves easily under operating conditions. The Walschaerts valve gear is in itself light, and its resistance to shifting is thus reduced. The cable and wheel will give a finer adjustment than even a reverse lever on a quadrant with fine noteches. One of the ideas in the use of this gear is that the engineman in handling it "feels" the condition, as far as lubrication is concerned, of the main valves, because if they become too dry the effect is apparent to him as soon as he attempts to move the reversing wheel. The ordinary reverse lever is not present, and the wheel mechanism used makes a more compact arrangement in the cab, while it retains the same "personal touch" feature which other forms of gear may lack.

In dealing with the engine, the designer, Mr. S. G. Thomson, Superintendent of Motive Power and Rolling Equipment of the P. & R., believes that the equalizing and guiding of long locomotives is a highly interesting problem. The example which we have here briefly described will afford opportunities for careful experiments on this and the smooth riding qualities of engines running at high speeds.

The support of the rear end of this locomotive by means of a truck, which is itself equalized, introduces the new feature in the matter of weight suspension in which the weight of the rear end of the locomotive is not tied in with that on the driving wheels. The equalization of rear truck and drivers could, however, be easily accomplished if necessity should arise, but at present the method here employed will be the subject of careful observation so that the facts about it, when brought out in everyday practice, and analyzed, will add to our knowledge of the whole subject. It is expected that the separate carrying of weight on rear truck and on drivers will tend to relieve the drivers of any undue pressure when the engine passes over any unevenness in the track. In this regard, the 4-4-4 P. & R. is, in a sense, not unlike the "Singles" used in the early days of the railroads in Great Britain, where one pair of driving wheels in the centre was unconnected with the pair of leading wheels, and a pair of trailing wheels. Although the "Singles" have practically disappeared, they gave satisfaction while they ran, and even if the weight was less than that of the P. & R. engines, yet there is no reason why a similar practice may now be found to yield satisfactory results. The engine shown in our illustration is now in service with three others of the same class. The P. & R. therefore have four of these high-speed machines at work.

Specifications and Sizes, Ratios, etc.

Weight of engine and tender in working order	390,800 lbs.
Wheel base, driving	7 ft. 3 ins.
Wheel base, total	33 ft. 3 ins.
Wheel base, engine and tender	63 ft. 1¾ ins.
Weight on drivers ÷ tractive effort	3.99
Total weight ÷ tractive effort	6.30
Trac. effort × diam. driv. ÷ equiv. heat surf.	835.00
Equiv. heat surface ÷ grate area	32.5
Wt. on driv. ÷ equiv. heating surface	41.6
Total wt. ÷ equiv. heat surface	65.80
Vol. of both cylinders in cubic feet	13.10
Equiv. heat surface ÷ vol. cylinders	268.00
Grate area ÷ volume cylinders	8.24
Main valves (piston) diameter	13.00
Full valve travel	7 ins.
Outside lap	1⅜ in.
Inside clearance	¼ in.
Lead in full gear	5/16
Engine truck and trailing truck wheels	36 ins.
Boiler—Wootten type—outside ring, dia. of 1st	72 ins.
Firebox length and width	144¼ x 108¼ ins.
Firebox water space	5 ins.
Tubes (2 ins. outside diameter), number	225.
Flues (superheater), number	32
Flues (superheater), outside diameter	5⅜ ins.
Tubes, length	13 ft 6 ins.
Heating surface tubes and flues	2,199 sq. ft.
Firebox, heating surface	292 sq. ft.
Total heating surface	2491 sq. ft.
Superheater heating surface	679 sq. ft.
Grate area	108 sq. ft.



General Plan of 4-4-4 "Reading" Type Passenger Engine P. & R. Ry.

Organization and Shop Methods at Morris Park

THE LONG ISLAND RAILROAD operates 165 steam locomotives, 551 electric motor cars, 537 passenger cars and 1629 freight cars. The chief shop is at Morris Park, Long Island, which is in personal charge of the superintendent of motive power. The shops were built in 1889, and when parts of the road were electrified in 1905, the electric shop was added to the existing car shop.

In addition to the round house, power house and office building, there are the locomotive shop, in which locomotive repairs, boiler repairs, all machine work, air brake equipment repairs and drafting room are located; the smith shop, which is close to, and works in connection with, the locomotive shop; the car shop which houses the mill work, car repairing, paint shop, cabinet shop, pattern shop, upholstery and curtain shop, as well as furnishing space for the electric shop. Other smaller buildings are the battery house, fire house, flue house and compressor house, which furnishes air for the shop and also for the interlocking plant at Jamaica, a mile distant. These various shops come under the immediate jurisdiction of general foremen who report direct to the Superintendent of Motive Power.

The General Foreman of Locomotive Repairs is responsible for the locomotive shop, the smith shop, flue shop, boiler shop and air brake work. The General Foreman of the Car Department handles the car repairs, painting, upholstering and steel car work. The General Foreman of Electrical Equipment has charge of the maintenance of all electrical equipment, including armature and field winding work, the impregnating plant, connecting and disconnecting all electrical work, caring for batteries and the electrical work around the shop.

All work going through the shop is handled on a time schedule. When a car comes into the shop, the Inspector and Car Foreman go over it, decide what class repairs it requires, and schedule it through.

Fig. 1—Spring Tempering Furnace.

As an example of this time scheduling, the locomotive shop schedule is reproduced, which, with that of the boiler shop, covers the complete list of locomotive repairs. Two horizontal lines in the schedule are given to each locomotive when it is to be shopped, and the General Foreman of Locomotive Repairs on the line "Due" puts a date in each column on which the work is expected to have progressed as stated at the top of that column. On the date on which delivery of the boiler to boiler shop is indicated, the boiler schedule becomes effective. A man thoroughly familiar with locomotive repairing processes checks up every locomotive in the shop each morning and reports back to the General Foreman, whether the work "Due" is "Done." A date placed directly below each "Due" date gives the date of completion, and where there is any discrepancy the department foreman's attention is called to it immediately, and it is recorded against him as a "failure."

Fig. 2—Oil Bath and Circulating Pump.

Each week a meeting of all department foremen under the General Foreman of Locomotive Repairs is held and these "failures" are put to the department foremen for explanation. Then, with their explanations, a record of the "failures" is forwarded to the Superintendent of Motive Power. In case of conflicting reasons for a failure, such as one foreman claiming to be held up by material due from another foreman or from store, the differences of opinion are sifted by the General Foreman before the report goes to the Superintendent of Motive Power. At these meetings also the work in the various departments is discussed and the General Foreman makes use of this information in scheduling the next locomotives, demanding faster results from departments where work is slack than from those where work had piled up for some reason.

The management is not averse to a small number of "failures," as without these it could be assumed that some department had time on its hands and that the shop was not working to capacity. The practical men in charge know that unavoidable delays are bound to occur, and they make allowances, at the same time demanding an explanation of every failure to get work out on schedule

LONG ISLAND RAILROAD MORRIS PARK SHOPS

SCHEDULE OF LOCOMOTIVES RECEIVING REPAIRS

Gang No.	Engine No.	Class Repairs.		1 Rods, driver brakes, ash pan, exhaust pipe, netting, pilot, all pipes and reservoirs, boiler checks, fire doors and frame, pedestal braces, eccentric rods, links, guides, steam chests, cylinder heads, piston, air pump, hand rails, bell and head light all removed. Steam pipe test.	2 Driving wheels, engine truck, spring rigging, rocker boxes, lift shaft, driving boxes, eccentrics and eccentric straps, frame pads, clamps, cab brackets, running boards, jackets and lagging all removed. Parts cleaned and delivered. Frame braces, cylinders, wheels and axles cleaned and examined.	3 Flues out. Boiler cleaned. Start boring cylinders. Frame bolts renewed. Jaws faced. Cab removed if necessary. Repairs to distributed parts started. Boiler delivered to boiler shop if Class 2 or side sheet repairs.	4 Repairs to boiler and fire box started. Pedestal caps closed. Repairs to frame pads and clamps started. Repairs to shoes and wedges started. Driving wheel tires turned or renewed. Heavy boiler work complete and boiler delivered back to erecting gang.	5 Repairs started on driving boxes, eccentrics and eccentric straps, driver brake, sand box and bell. If back flue sheet or mud ring corners—back flue sheet out, mud ring to smith shop.	6 Pedestal caps up. Holes reamed and bottoms fitted. Back cylinder heads and casings erected. Dry pipe in and Tee head up. Fitting up on spring rigging. Cylinder saddle bolts all in. Mud ring complete in smith shop on Class 3 repairs.	7 Guides up. Lift shaft and bearings up. Cellars and saddles fitted to driving boxes. Shoes and wedges laid off and planed. Steam and dry pipe joints ground if removed. Air reservoirs repaired and tested.	8 Cross heads applied. Rocker boxes up. Bell and sand box erected, except D-16-B engines. Running board brackets up on narrow box engines. Valve seats faced. Cab brackets up. Stack up.	9 Steam chests and valve yokes up. Mud ring complete on machines.	10 Eccentrics and eccentric straps put on axles. Wheels completed ready for engine.	11 Bridge pipe up. Boiler cocks in dome cap on. Spring rigging up, except D-16-B engines. Washout plugs and hand hole plates on. Stand pipe in.	12 Resetting of flues completed. Driving boxes on axles and cellars sponged. Grate bar studs renewed.	13 Boiler tested, pads and clamps replaced. Engine truck completed. Cab side sheets and deck plates up. Cab and cab saddles up. Lubricator up. Running board brackets up on wide box engines.	14 Steam and exhaust pipes in. Boiler lagged and start applying wheels. Links up. Steam chest lids on. Welding of flues completed. Piston valves erected.	15 Applying wheels completed. Jacket on pedestal. Binders, shoes, wedges, quadrant, reverse lever, reach rod, all up. Air drums and reservoirs up.	16 Ash pan up. Valves set. Air pump, brake, valve, injector and hand rails up. Netting in. Pilot and braces on. Spring rigging up D-16-B engines.	17 Grates, fire doors and frame erected. Pistons in. Cylinder heads and casings up. Rods applied. Driving brake completed. Repairs to tender completed. All pipe work completed. Clamps all made and part applied. All painting done except pipes and clamps. Pipe test on engine and tender started.	18 All brake and steam pipes completely clamped. Cylinder cocks and rigging, headlight, signal lamps and tools applied. Pipe test completed. Painting all done. Engine out and tender coupled.		Gang No.	Engine No.	Class Repairs.
			Due																			Due			
			Done																			Done			
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LONG ISLAND RAILROAD MORRIS PARK SHOPS

SCHEDULE OF LOCOMOTIVES RECEIVING HEAVY BOILER REPAIRS

Gang No.	Engine No.	Class Repairs		1 Boiler delivered to boiler shop. New fire-box sheets layed out.	2 Flues removed. Mud ring rivets and corner plugs out. Flanges delivered to drill press. Staybolt iron delivered to smith shop.	3 Flanges drilled and delivered to boiler shop. Mud ring out and delivered to smith shop.	4 Staybolts drilled in outside sheet. Belly braces cut loose. Box cut loose at hip or back. Head out.	5 Side sheets out. Radial staybolts delivered to machine.	6 Staybolts broken down in crown and side sheets. Old box out. Smith work on mud ring complete and delivered to machine.	7 New box built. Boiler cleaned. Side sheets in. New box in.	8 Connection or back head riveted, chipped and caulked. Mud ring delivered to boiler shop.	9 Mud ring in and riveted. Side sheets riveted, radial staybolts delivered to boiler shop.	10 Side sheet, back head and throat sheet staybolt holes tapped. Belly braces applied.	11 Staybolts applied, cut off in side sheets, back head and throat.	12 Crown staybolt holes tapped. Mud ring chipped and caulked.	13 Crown staybolts applied and cut off.	14 Staybolts riveted in side sheets, back head and throat sheets.	15 Staybolts riveted in crown sheets. Applying flues.	16 Patch bolting, fire-door holes.	17 Boiler delivered to erecting gang.	18 Flues and door holes complete.		Gang No.	Engine No.	Class Repairs
			Due																			Due			
			Done																			Done			
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Fig. 3—Saltpeter Bath.

This system gives the General Foreman an opportunity to judge for at least six weeks ahead just about how busy a given department is going to be and he can more systematically arrange his program with this information in view.

In the electrical department and car departments this scheduling is of great value in avoiding conditions where different gangs would be losing time trying to work in the same place at the same time. As the car is scheduled such conflicts are guarded against, and the rigid enforcement of the schedule dates carries these precautions to fulfillment. A "failure" to maintain the schedule date for given work is considered serious, not alone in itself, but for interfering with other work being completed as scheduled.

Once each month the General Foremen meet with the Superintendent of Motive Power for a staff discussion of the work, including "failures" in each shop during the past month, and for arranging programs for the future. These staff meetings are found to be very valuable in maintaining a spirit of co-operation between the different units of the force. A weekly shop inspection is made and reports turned in from the standpoint of safety, fire risks, condition of machinery, etc.

In gathering the material for the description of the shop organization, a number of the individual shop practices were observed and some of these are reported, not with the idea that they will be new to everyone, or even that they may have originated entirely in this shop, but rather to offer them as suggestions to any shops where similar problems can be solved by these methods.

Fig. 4—Spring Assembling Machine.

One of the most recently completed improvements is in the Smith Shop, where the outfit for making and repairing springs has been re-designed and rebuilt. These improvements displace an old style coal furnace with which the springs were tempered and drawn on the old flash system.

The new muffle type oil furnace has been successfully designed to maintain an even temperature during heats. This is shown in Fig. 1, with a spring on the platform ready to be put into the furnace. Near the left margin of the picture can be seen the table on which are mounted the rolls. In Fig. 2 is shown the oil bath, which is surrounded by a water tank. In connection with the oil tank is a small force pump, which may be seen in the lower right hand corner. This pump causes a circulation of the oil through cooling pipes in the water jacket, taking the hot oil from the top of the bath, cooling it and returning it to the bottom. Fig. 3 shows the saltpeter bath. This bath is built over a gas furnace which maintains the proper heat. The saltpeter bath and the tempering furnace are both connected to a two-point electric pyrometer which can be seen against the back wall on the left side of Fig. 1. This pyrometer enables the men to keep a very close check on the working temperature.

The spring leaves, after being formed, are heated to 1550 degrees F. dipped in oil and reheated to 1350 degrees for annealing purposes, before the final tempering. The springs are tempered at 1450-75 degrees, dipped in oil, drained, and drawn to 750-60 degrees in the saltpeter bath. They are then cooled and washed and ready for banding.

The operation of banding is performed on a machine designed and built in the shop, which dispenses with the old screw clamp. The assembling machine shown in

Fig. 5—Spring Banding Machine.

Fig. 4 employs air pressure in an old driver brake cylinder. The spring is assembled horizontally on a table, the air pressure applied and the spring turned, while still gripped, to the vertical position in which it is shown. The hot band is slipped down over the top and the spring slid to the right, into the bander. In the bander, Fig. 5, a pair of old driver brake cylinders and some old "I" beams and channels have been built up in such a way that a pressure of fifty tons can be exerted both vertically and horizontally. All fittings on this machine are forgings. After banding, an air hoist removes the completed spring, dips it in water to cool the band, and it is ready for service.

Another furnace that has been built at Morris Park is in the Boiler Shop, used to anneal fire box sheets, and for repair work in connection with steel cars. The furnace, shown in Fig. 6, uses fuel oil and combines the use of compressed air, passing through a small orifice, to spray the oil, with a blast from a centrifugal fan. An opening 1/16 inch in diameter for compressed air is used. A pressure reducing valve is used to secure the 30-lb. pressure and a small reservoir to maintain even pressure as

Fig. 6—Sheet Annealing Furnace.

the same line is connected with the door operating mechanism. This furnace seems to be giving very satisfactory results. A diagram of the burner is given in Fig. 7. A heat chart representing 1375 degrees F. is used to assist in determining the check temperature.

Electric welding is used to a considerable extent in the boiler work, and is replacing flanging and riveting on other work such as corner joints in sheet steel work—in steel door and other steel car repairing. Dies and tools have been arranged with which such flanging and pressing work as is necessary can be done with the boiler shop tools.

The tire heater shown in Fig. 8 has some novel points of construction. The oil and compressed air supplied through the feed pipe pass through an air gap of some

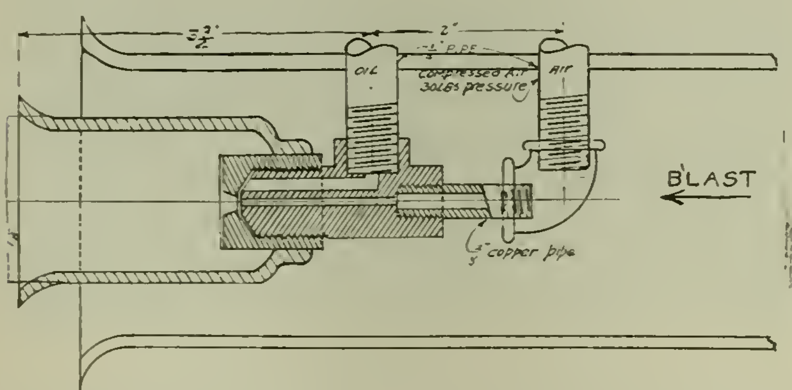


Fig. 7—Cross Section of Oil Burner in Annealing Furnace, Using Compressed Air and Blast.

distance before entering the circular pipe surrounding the tire. A certain amount of outside air is drawn into the vapor in this manner. The further advantage is offered that it takes only a moment to set up the heater for any size tire. When the proper burner ring has been selected and placed, it is necessary only to lay the end of the feed pipe in position and the heater is all ready.

When this road began to use superheater engines, the superheater flues offered a problem in the flue shop that called for either a larger flue welder or an adaptation of

Fig. 8—Tire Heater in Operation.

the present machine to weld flues from 2 ins. to 5½ ins. in diameter. The latter course was chosen, and the well-known Ferguson type machine was equipped with a larger air cylinder to give sufficient thrust for large superheater flues. As this gave too much pressure for small flues, a pressure reducing valve was introduced, with a by-pass valve in such a way that any desired pressure could be secured. To obtain the range from 5½-in. flues to 2-in. flues on the same machine a set of change gears were provided, with the necessary spacing blocks, Fig. 9. With this addition the flue house is able to take care of all flues without increase in equipment or operating force. The road is now using nine superheater locomotives, three of which have been converted from saturated steam locomotives in the Morris Park Shops. Four more locomotives are programmed to be converted this year, and this work will all be done in the shop.

A development in the right direction is a boring bar used on the car wheel boring mill. The wheel work in this shop covers a wide range, due to the fact that the Long Island R. R. maintains wheels varying in size from those used on trolley cars to those for large multiple unit electric motor cars. The difficulty of fitting wheels to axles, especially on large steel hub wheels, requires a boring tool that can be adjusted with the greatest accuracy. The bar is shown in Fig. 10. The cutters on this bar are arranged with reference to an indexed regulating screw so that they can be turned in or out and their movement controlled to a fraction of a thousandth of an inch.

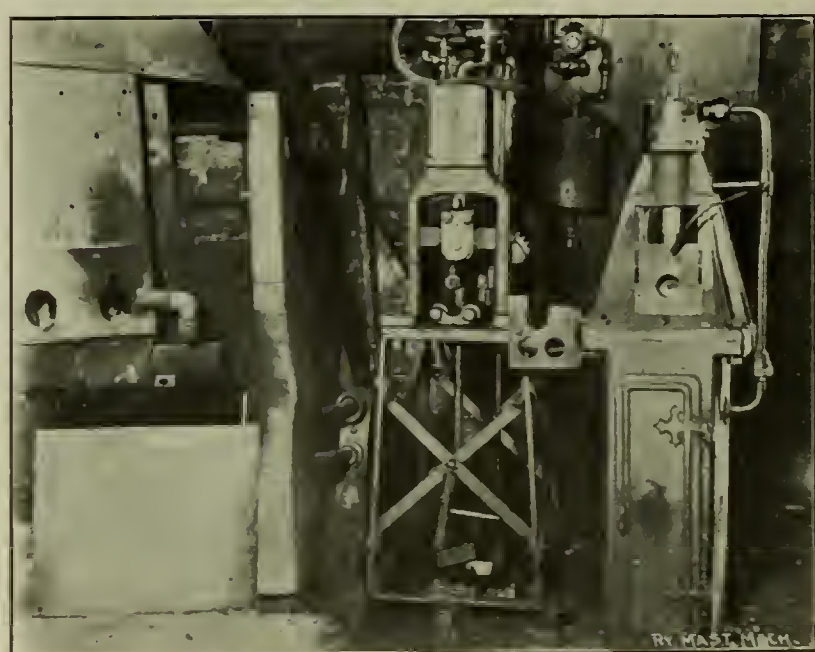


Fig. 9—Flue Furnace and Welding Machine.

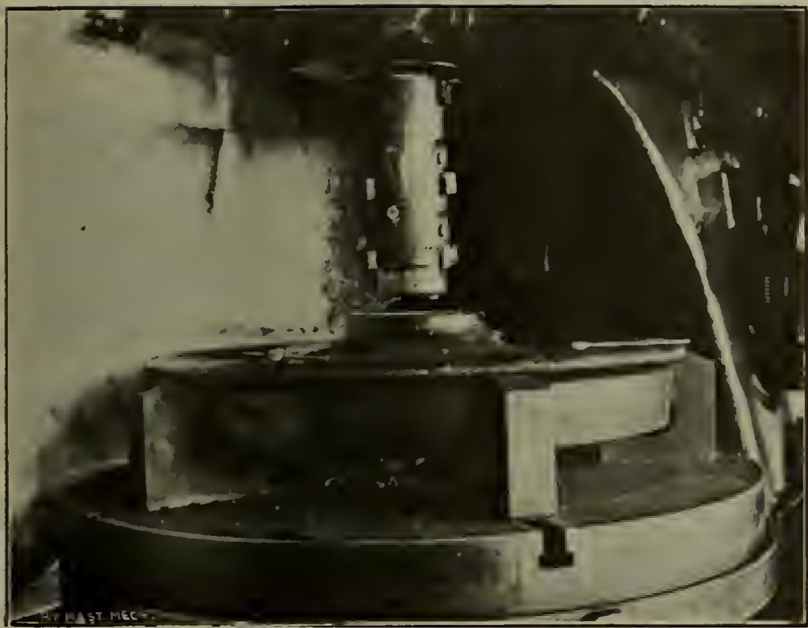


Fig. 10—Wheel Boring Bar.

The axle to be fitted is calipered and the tool set to a snug fit. By the use of the circular index scale in connection with the regulating screw, each division on the dial of which represents .002 of an inch of diameter or .001 of radius, the cutter can be backed off any required amount for fit. A definite allowance for fit is thus made and not a haphazard tap with a wrench. Both the upper and lower cutting tools shown in the illustration are fitted with this feature.

Nearby stands a machine on which contact shoes for third rail trucks, are jigged and bored for the holding bolt. If the shoe did not ride at the proper height while idle it might not strike the "riser" at the end of the third rail and be lifted to its proper position on the rail. The gauging and jigging of these shoes becomes, therefore, a matter of importance.

For this work a three spindle multiple drill had been used for years. A recent addition to the shop equipment is a high duty radial drill with two box tables on which are mounted the jigs, Fig. 11. As the ears or wings of the contact shoes are drilled from opposite sides, the jigs have 180 degree index scales. As soon as a contact shoe is clamped to the jig the drill is started on one side and when this is drilled, the jig is turned 180 degrees and the other ear bored. While this is being done the operator removes the contact shoe from the idle jig and clamps on the next shoe to be drilled.

The drill arm is fitted with adjustable stops, and when the drill is moved from one jig to the other the drill registers quickly and accurately with the jig, and no time need be wasted in centering the drill. The new equipment makes possible an average speed of 45 contact shoes per hour with one man. The old equipment reached its maximum at 18 shoes per hour. Some share of the increase in efficiency of the new drill must be credited to its being a high duty machine, but, on the other hand, the use of only one drill as against a multiple drill press leaves the advantage very much in favor of the radial drill.

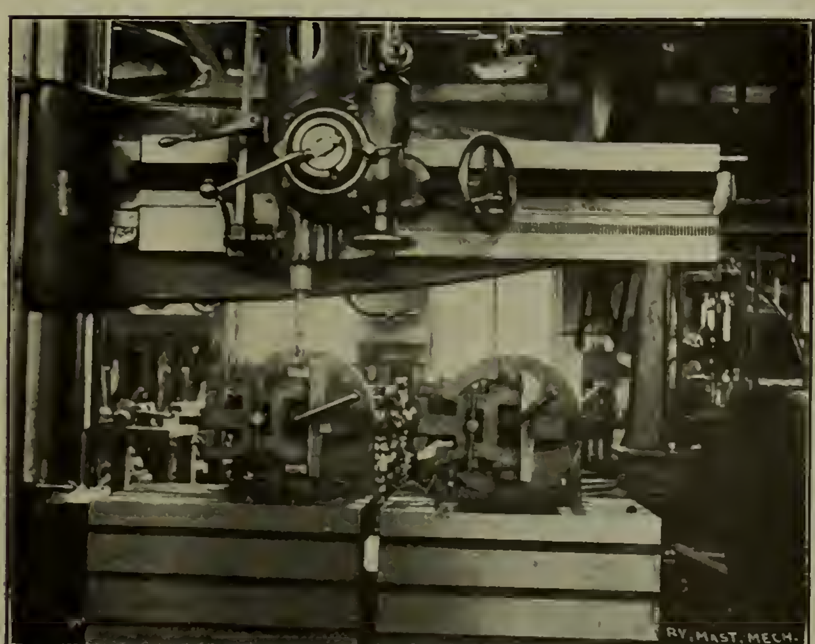


Fig. 11—Radial Drill Boring Contact Shoes—on Two Jigs.

A novel type of locomotive cylinder lubricator has been applied to some of the larger locomotive cylinders, as shown in Fig. 12. The General Foreman of Locomotive Repairs, after experiencing difficulty in lubricating some of the larger locomotives, experimented with the use of graphite and designed a cup for feeding flake graphite. The cup embodies the differential piston idea, utilizing the pressure of steam in the cylinder, and the piston travel can be regulated. Only a very small amount of graphite is used—from one-half to one ounce per hundred miles run for both cylinders. With this cup, longer life of cylinder packing rings and cylinder rod packing has resulted, as well as less trouble with cut valve seats and piston valve chambers as the case may be.

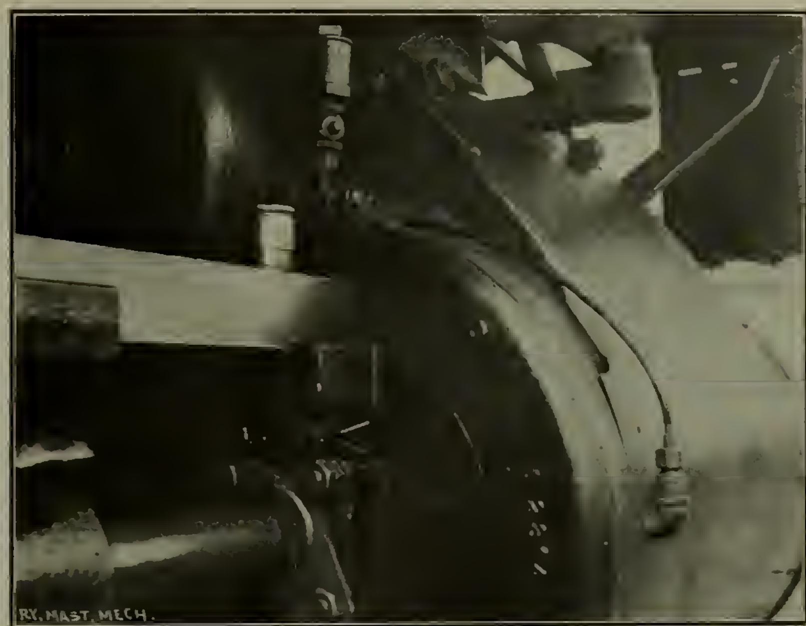


Fig. 12—Graphite Cup.

The large proportion of electric equipment on this road throws some work on the air brake department that is not encountered in shops where electricity plays a less important part. All of the electro-pneumatic work is done in the air brake shop, and some phases of this work differ enough from steam practice to attract attention. The compressors on electric trains are of course motor driven, an individual compressor to each car.

The problem of local transportation between and in the shops has been solved by installing a one and a half ton electric delivery truck, which runs on a regular schedule repeated twice each day, morning and afternoon, making it possible for any foreman to plan ahead when the truck will be available for use in his shop or in supplying him with material. This truck is under the supervision of the storekeeper. The truck has been "logged" periodically and a careful time study made by which empty return trips and interruptions of schedule have been eliminated as far as possible. Parallel brick tracks have been laid of the proper width and distance apart to serve as pavement for the truck between the different shops without the expense of laying a solid roadway full width.

Quite recently two one ton electric industrial trucks have been added, one of which is shown in Fig. 13, for

use in the shops, in the aisles too narrow for the standard width truck, and in the passageways between machines. It is expected that these small trucks can replace the labor of half a dozen men.

In the passenger car shop a pair of cranes have been equipped with jaws, which operate not unlike ice tongs, for lifting cars off of trucks. When the cars come in to the shop for repairs they are run under these cranes, shown in Fig. 14. A special cantilever construction on the underframe provides four points from which the car can be lifted, and after the jaws have been placed in position and necessary wiring disconnected, the car is lifted off the trucks, without any jacking, see Fig. 15. The trucks are then run out (Fig. 16) on the transfer table to be sent to the proper place for repairs and dummy trucks substituted to carry the car through the shops. The two cranes have a capacity of 40 tons each and are able to handle any of the equipment in service.

An electric tractor truck is used to pull and push trucks and cars from the electric transfer table to the various shop tracks. This truck operates from a third rail installation on the table. In the car shop a novel air hoist running on a suspended track furnishes the means for shifting wheels from one end of the shop to the other.

Fig. 13—One-Ton Industrial Truck.

Fig. 14—Jaws for Lifting Cars—on Cranes.

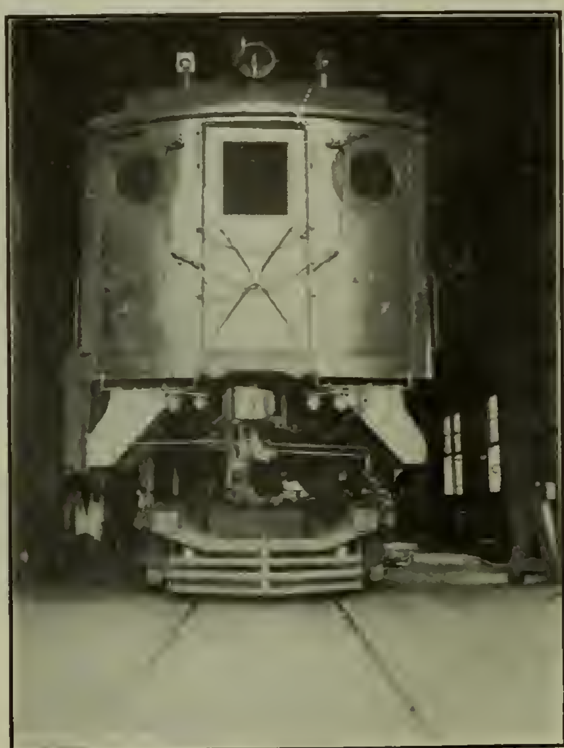


Fig. 15—Car Lifted Off of Trucks.

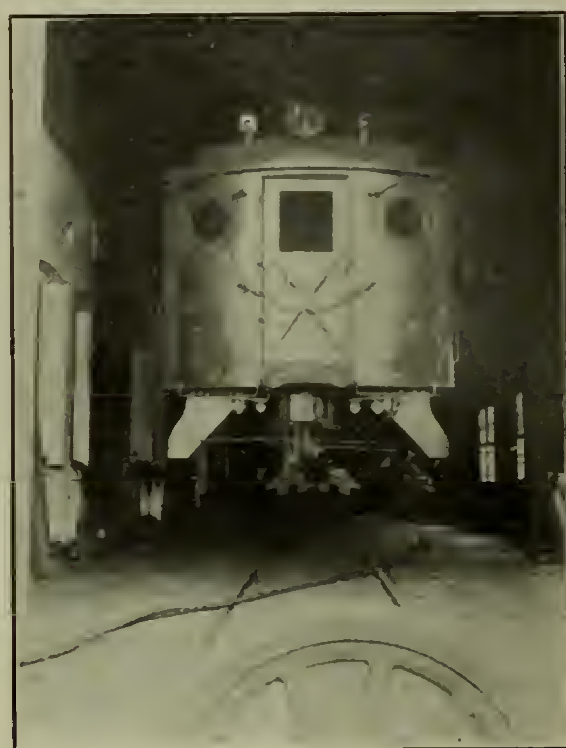


Fig. 16—Car Held in Without Jacks While Trucks Are Run Out and Dummy Trucks Substituted.

For fire protection the shops are equipped with hand extinguishers, buckets and high pressure water outlets with hose. The men are organized into two companies and regular drills are held each week. A modern fire alarm system has recently been installed signaling to the Superintendent of Motive Power in the same manner that city fire alarm systems indicate to the fire chief the neighborhood of the fire by the location of the box from which the call originated. When a fire drill is held the signal is rung at an unannounced hour and a record is taken of the time necessary for the men to form their companies, get to their fire apparatus, reach the location of the box from which the alarm was turned in, and play a stream of water on the imaginary fire. Very satisfactory results have been secured by this method.

Practical Hints From Railway Shop Men

ADJUSTING WALSHAERTS VALVE GEAR

By Charles A. Curtis, Jr.

A great many shop men, employed by the various railways, do not understand the Walschaerts locomotive valve gear as they should, although it has been frequently described in the technical magazines.

The following diagrams show all of the cases of the gear, with names of parts familiar to the shop man.

Direct drive engines are considered the best, therefore direct gearing only is shown in these diagrams. To make either of these gears indirect it would be necessary to reverse the eccentric crank and the reversing shaft. In that case the forward motion would be controlled by the top of the link, therefore the valve stem readings would be the reverse of a direct drive engine, consequently the alterations would be to the reverse also.

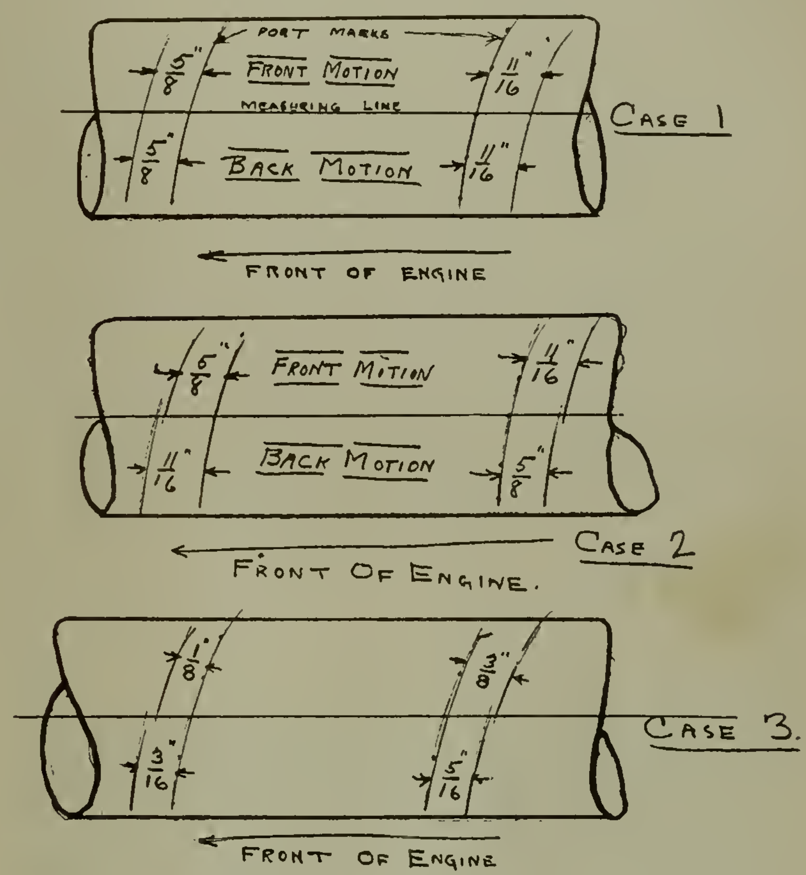
When the engine comes in the shop it is stripped in the usual manner, all working parts are repaired, lost motion taken up, and new bushings and bolts are applied when necessary. After the engine is completely stripped the work of rebuilding begins. Suppose a new cylinder or a new frame is applied. This naturally is apt to throw the pedestals out of alignment. That difficulty is taken care of when the shoes and wedges are laid off. Often new ends are applied to eccentric rods, radius rods, etc., and therefore it is a very rare occurrence for the engine not to have its valves reset.

We will assume that the motion work is erected, all bolts and pins tight, all joints working freely, and that the port marks are scribed clearly on the valve stem with a tram suitable for that class of engine.

Now locate the central position of the reverse bar and place it in this position, after which have the radius rod hangers adjusted so as to bring the radius rods in the exact central position of the links. Mark the central position of the reverse bar on quadrant of same and then push the bar ahead until the radius rods are about 2 ins. from the center of the links, making sure that the latch is in a notch. Mark the quadrant again in the same manner as at central position, and at the same distance back of the central position mark another position for the back motion. This is done so that a uniform reading will eliminate any lost motion and prevent an error in the valve travel.

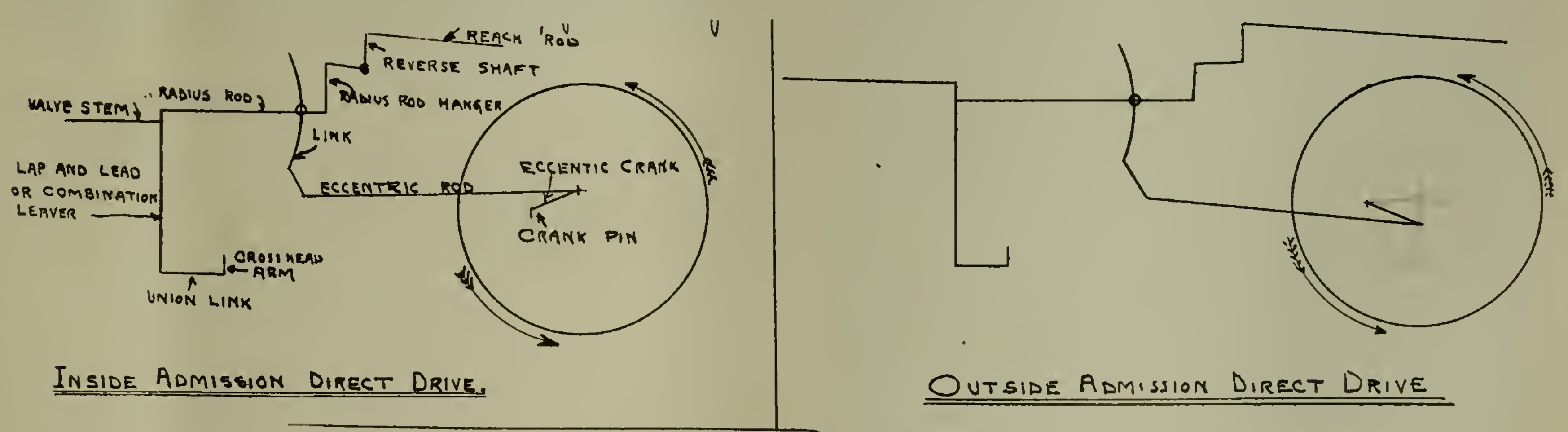
Now that the valve stem has been trammed, the changes necessary to divide the valve travel over the port marks must be figured. Since lap and lead are constant in these engines, all that is necessary is to divide the travel.

Since the reverse bar is placed at an equal distance from its central position for each motion's tramming, we



Diagrams of Valve Stem Marks.

are sure of a uniform stem reading, which is much easier to understand than if the bar had been placed haphazardly for the tramming. A few illustrations of stem reading are shown. A measuring line should always be drawn along the side of the valve stem, through which both back and forward motion tram marks should extend a little way. The machinist should always measure the



Skeleton Drawing of Walschaerts Valve Motion.

may be obtained when the stem is trammed. The reverse bar is placed at the forward mark, before stated, on the quadrant, and the engine is pushed forward very slowly, while the valve setter marks the stem with a tram. The same applies to the back motion. The engine should always be moved in accordance with its reverse bar, which travel marks on this line. These three cases illustrate every reading that might show on the stem. Of course each may work out to the opposite of the given illustrations, but in every case these principles apply.

In Case 1, both motions show up as being out exactly the same distance, and both show that the radius rod is

too short. The readings for both motions are the same, ⅝ in. ahead and 11-16 in. back. 11-16 in. — ⅝ in. = 1-16 in., and 1-16 ÷ 2 = 1-32 in., the distance the radius rod must be lengthened. If the reading was opposite, the radius rod would have to be shortened.

Case 2 shows the forward motion traveling ahead too far and the back motion travelling too far back. In this case the eccentric rod must be changed. Now to do this we will find the difference in the location of the travel of each motion.

The forward motion travels 11-16 in. back and ⅝ in. ahead. Therefore, 11-16 in. — ⅝ in = 1-16 in. ÷ 2 = 1-32 in. change. Since the back motion readings were to the opposite of the forward we find a 1-32 in. change in the back motion, and know that the forward motion must be moved back 1-32 in. and the back motion ahead 1-32 in. In this case the eccentric rod must be changed.

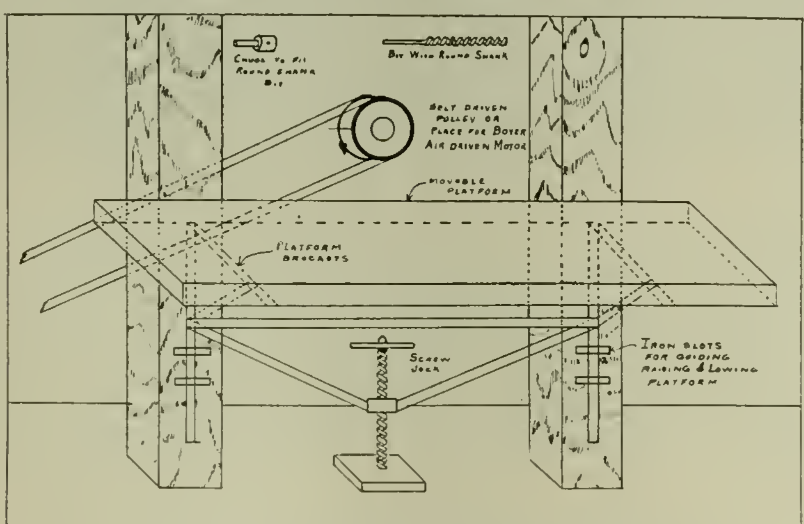
As the trammings were taken with the radius rods 2 inches from the center of the link we can easily find the change necessary. Say the distance from the center of the link to the center of the eccentric rod pin in the bottom of the link is 20 ins. Divide that by 2 ins. = 10 × 1-32, or 5-16 in. longer the eccentric rod must be made. In case readings are to the opposite, then the eccentric rod must be made shorter.

Case 3.—In this case the eccentric rod and the radius rod both have to be changed. This operation requires the use of both case 1 and case 2. First ascertain how much to alter the eccentric rod by means of case 2. Then by means of case 1, the radius rod change can be worked out very easily.

I believe these instructions can be understood by the practical man who possibly has not had the opportunity to get a technical education.

NOVEL WOOD BORING MACHINE.

This home-made device can be put up so as to occupy the space between two wooden posts in the shop, and in that case it is very much "out of the way." The table is supported on two brackets made of substantial flat iron bars, bent with one right-angle bend each. To these brackets is bolted a tie rod and a flat V-shaped support with a nut at its lowest point, engages with a lifting



Home-Made Table for Wood Boring.

screw, the point of which bears upon a piece of flat iron or boiler plate laid on the floor.

Between the shop-posts a belt driven pulley is secured or a Boyer air-driven motor, taking air from the shop system, may be placed. A suitable chuck receives the bit and when motion is given to the apparatus, the table elevated to the proper height, the man who operates it finds himself in charge of an exceedingly handy machine which may increase his output very materially.

MACHINE FORGINGS AT THE ANGUS SHOPS

By William Nicholson, Foreman Blacksmith.

In Fig. 1 is shown what is a very good example of the method employed here to shorten the shackle bar between engine and tender. Frequently this bar lengthens and leaves too much play between the back casting on the engine and front casting on the tender. A sliding wedge between the two takes up the lost motion, but when that is "all in," and the lengthening goes on, the bar has to be upset.

The method we employ is first to ascertain the correct length required. This length, whatever it is, can be set on the device we use. The device consists of a very substantial holding bar with the two ends turned up. The

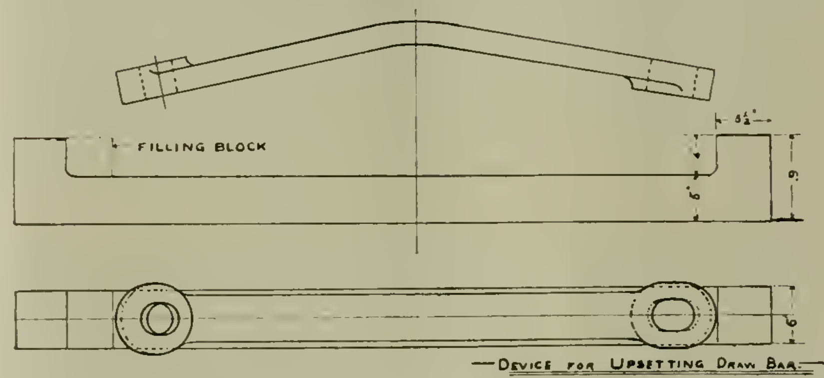


Fig. 1—Upsetting Engine Draw Bar.

required length is made by placing a filling block against one of the turned-up ends. The distance between the filling block and the other turned-up end is the required distance. The shackle-bar is heated in the centre and bent upward, so as to allow it to fit in the holding device. The whole is then placed under the steam hammer, and about two blows flattens the bar, upsets the iron where it is hot, and makes the bar the required length. This is all done with one heat, and the pin holes are not injured. The whole operation is simple and the work is comparatively easy to do.

The sketch illustrated in Fig. 2 shows a tube-swedging die. The work is done in a forging machine. A pair of grips hold the tube firmly. These are simply a pair

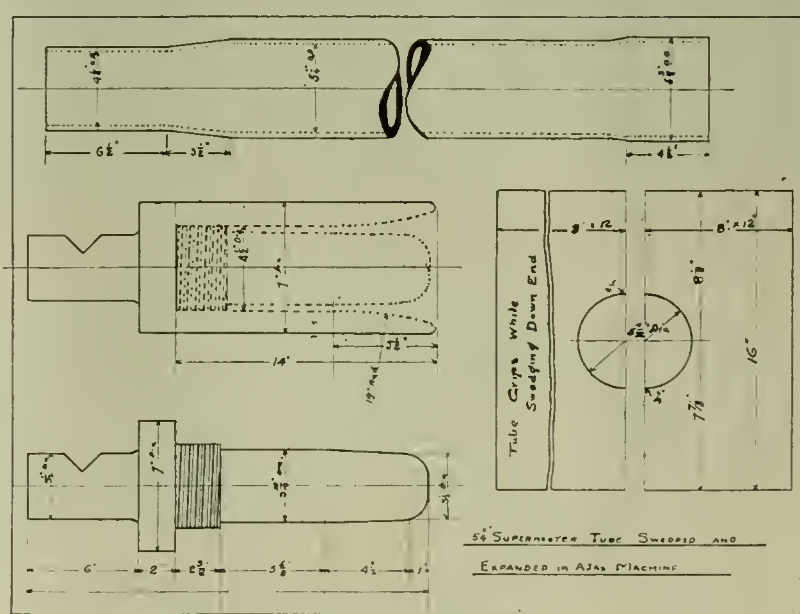


Fig. 2—Tube Swedging Device.

of blocks with semi-circular notches cut out to fit the tube. The superheater tube is heated and placed in position. The die consists of a hollow cylinder "belled" out to easily pass over the outer circumference of the hot tube. As the die progresses the bell shape forces the walls of the tube inward, and a slightly tapered plug screwed inside the bell-shaped die enters the inside of the tube.

The hot tube is thus forced to assume a smaller diameter by the action of bell-shaped die and plug and one stroke of the die is sufficient to accomplish the work. As the die is driven in to its full extent for each tube, a uniform amount is compressed on each, and the work thus becomes "standard." To expand the tube it is kept in the die and a ram is used to force it out to the required size.

Fig. 3 shows a spring banding die. The die consists of four pieces of axle steel, grooved to suit the iron for making the bands. As a rule, bands are made from ½

Fig. 3—Work Done on Spring Banding Die.

to ⅝ in. larger than the spring, in order that they may be very readily slipped over the spring. Usually when the band is pressed on, the surplus stock spreads, and works to the centre, and this often throws the band out of shape. The dies used here, however, put a neat-looking and close-fitting band on each spring.

A bulldozer die for various kinds of work is shown in Fig. 4. This die can be so easily and so rapidly adjusted when it comes to bending spring bands or other

Fig. 4—Die for Miscellaneous Work.

somewhat similar work that time is not lost changing dies as is often the case when carrying so many different sizes of tools. Fig. 5 gives an idea of the kind of forgings now being done at the Angus shops of the Canadian Pacific Railway at Montreal within the last six years, and this work, as machine forged here, has very materially reduced the cost of production.

Detroit, Bay City and Western R. R. of Bay City, Mich., are in the market for two heavy freight locomotives.

Hoboken Mfrs. R. R., Pres. & Gen. Mgr. C. D. Bayles, Hoboken, have for sale one electric locomotive and one steam locomotive.

The Cincinnati, Flemingsburg & S. E. R. R., of Flemingsburg, Ky., are in the market for one combination passenger and baggage car.

THE RE-DISCOVERY OF MANNERS.

The following is a recent editorial, says *The Gas Age*, taken from one of the leading Chicago dailies which applies as much to gas, electric and other public utilities as to railroads: " 'Courtesy meetings,' it appears, are to be organized by one of the great railroad systems of the country. It is felt that rudeness and boorishness on the part of conductors, brakemen, porters, clerks, and other employes of a carrier are neither essential nor unavoidable, and that neither strenuosity nor efficiency requires the sacrifice of good manners.

"If 'safety first' is a good slogan, 'courtesy second' is just as good. Time was in this country when busy and energetic men assumed tacitly that in trade and commerce manners were of no consequence. So long as the goods were 'delivered' what did mere words matter? Why waste precious moments—which any statistician could multiply into staggering periods of time and and enormous losses of money—on 'Please' and 'Thank you'? Why not leave all such empty and useless formalities to the absurdly ceremonious Latins, and show the world that business can be transacted in a downright and swift manner?

"These notions have been relegated to the limbo of crude ignorance. There has been a veritable rediscovery of manners in business. Efficiency is being separated from brusque discourtesy. Statisticians to the contrary notwithstanding, a billion 'Thank yous' will not 'waste' a single second. Manners may take time, but they bring money instead of taking it. Politeness and ability pay."

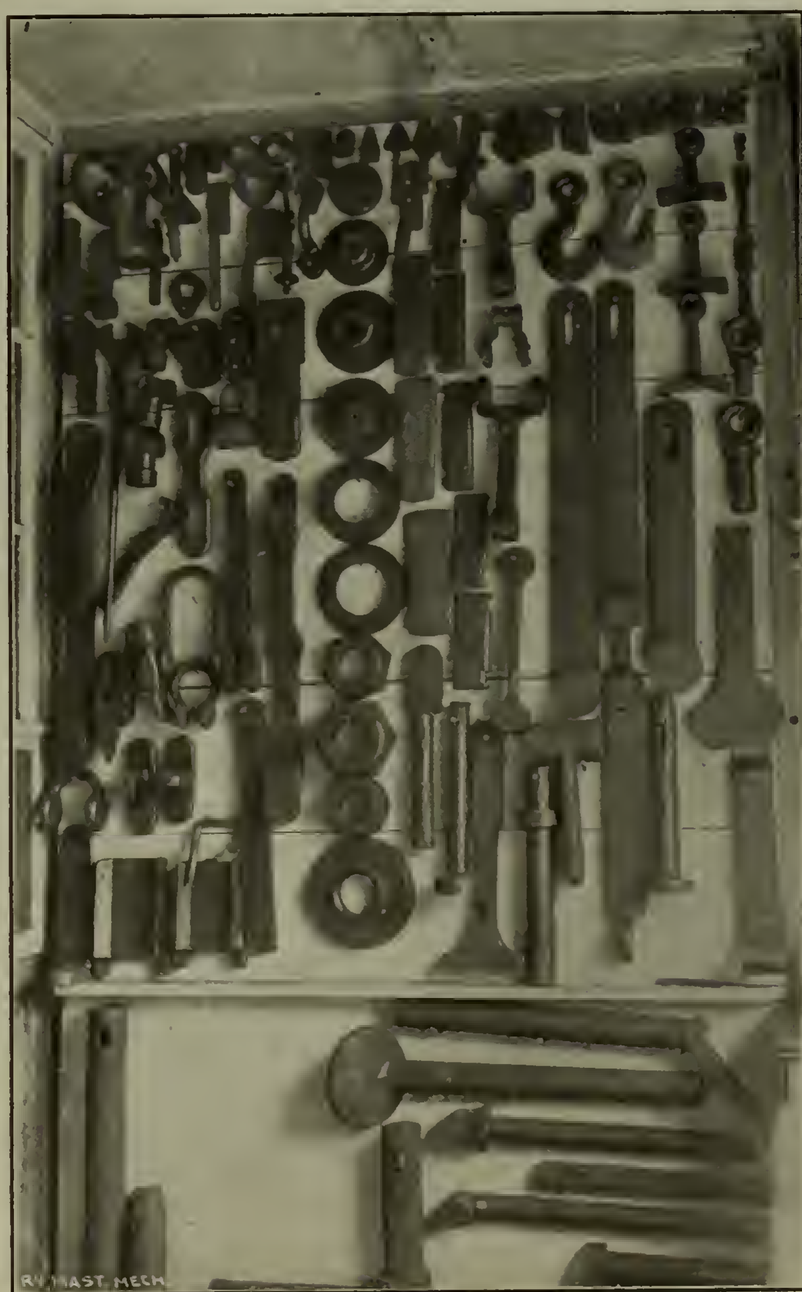
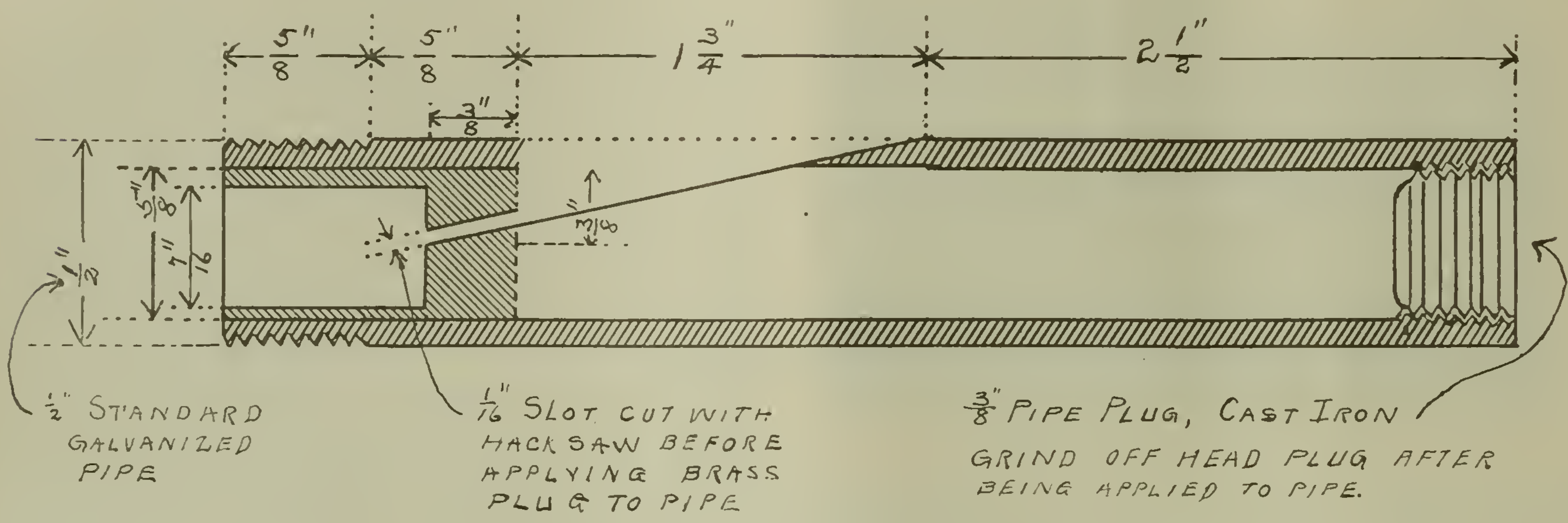


Fig. 5—Style of Forgings on C. P. R.

AIR WHISTLE

By Frank J. Borer.

The air whistle shown in the accompanying sketch is of the regular "organ pipe" type, but has been improved to prevent screeching if used at high pressure. This has been done by reducing the air inlet opening and arranging same to be in line with the inclined edge of the V-shaped slot or mouth of the whistle. This whistle is easy to make, and by lengthening or shortening the barrel of the whistle almost any desired note can be obtained.



Home-Made, Organ Pipe, Railway Whistle.

Since this style of whistle is now used for various purposes around large railroad shops and in yards, this "kink" may prove to be of help to others desiring to make up some kind of inexpensive whistle.

A SCIENTIFIC COMMENT.

Our correspondent has given us a very useful idea, and has incidentally raised the little-understood explanation of why a whistle, of the organ pipe variety, sounds at all. There is apparently no moving mechanism, and there is no reed to produce the vibrations in the air which give rise to musical sounds. This whistle, and indeed the steam whistle of a locomotive, is what is known as a "stopped organ pipe," that means the end remote from the mouth is plugged or stopped up. Whatever individual taste may incline one to say of the sound produced, it is technically a musical note.

The theory which accounts for its being able to produce the necessary vibration of the air is briefly that the jet of air is made to strike, not necessarily on the sharp edge of the upper lip of the mouth, but to slide along its outside edge. This causes an exceedingly small flow of air from the inside of the pipe, and produces a very mild partial vacuum inside the pipe. The minute outflow of air, thus induced, tends to push or blow the jet away from the upper lip, and so reduces the "pulling" action of the jet on the air inside the pipe.

When the jet is blown far enough away from the lip so that it cannot draw air out of the pipe, the outflow ceases. When the outflow ceases, the tendency to blow the jet away from the lip disappears and the jet swings back, and is even carried inward so as to help fill the pipe that it had previously robbed. When the pipe is full again the jet slides along the outer surface of the upper lip as it did at first, and the action of drawing out the air begins again.

In this way the jet acquires a swaying motion in and out, and thus the air inside the pipe is affected by an automatic reed made out of the swaying jet of air. This swaying motion of the jet, in and out, is very rapid. The out swing is followed by a slight pause, then the jet begins to swing inward toward the lip. It reaches it, and continues to sway inward and fill the pipe, then a momentary pause occurs, and the outward swing of the jet begins. This sequence of events is so rapid that a series of vibrations is produced capable of being recognized by us as a musical note. The theory here expounded makes bold to affirm that the sharp edge of the upper lip need not be sharp. It may be made quite blunt and the stream or jet of air must be so directed as to slide along the outer edge of the lip.

Some of our friends who have occasion to make a whistle such as that described by Mr. Borer might try the experiment of blunting the sharp edge of the upper lip of the mouth and let us know the result of the experiment. If it is true, it is worth knowing; and if false, the theory should be knocked on the head.—Ed. MASTER MECHANIC.

A ONCE SUCCESSFUL RAILROAD

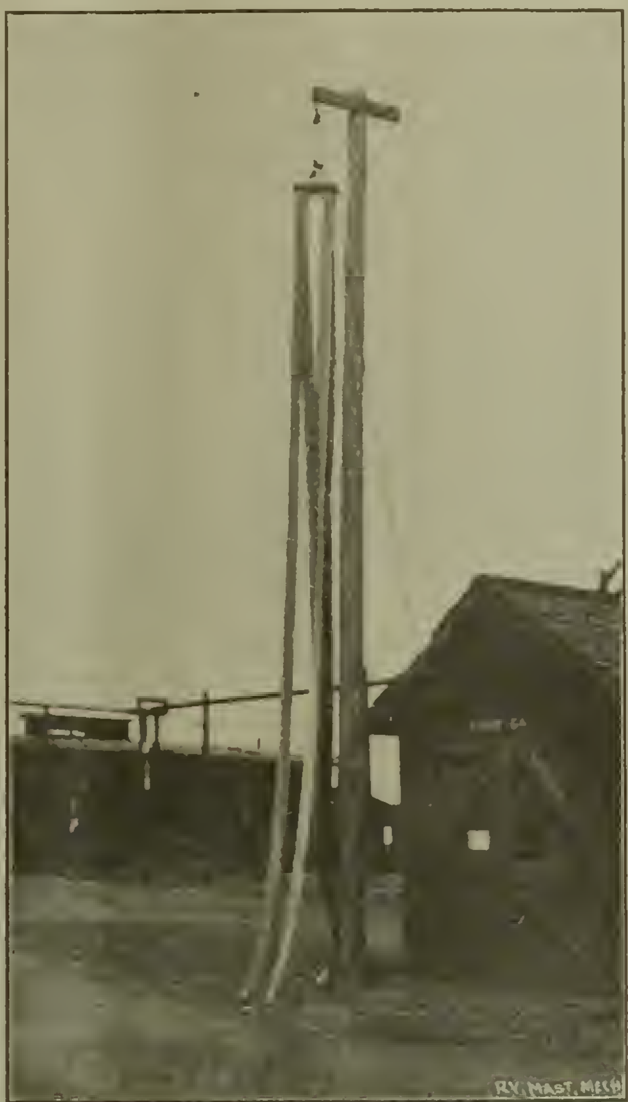
We often hear of successful railroads: properties which handle an enormous business at a small percentage of cost. Probably no more successful railroad than the old Marine Railway at Manhattan Beach ever existed. It was less than ½ a mile long, built on trestle work between Brighton Beach and Manhattan Beach, N. Y., with two stations only, one at each end of the line. A 5-cent ticket bought in advance and put into a box before one could enter the train furnished a through and continuous ride. This line was all under one management and had no policy. Two trains running frequently in opposite directions handled all the passengers, and unless one swam the distance one could not make the journey between the two beaches without paying the regular fare. It was not unusual to carry 20,000 passengers a day, and on Sundays and Saturdays the business was enormous. $1,000 per day was about the usual average receipts, out of which were paid the wages of the trainmen and ticket sellers. This force did not exceed 14 men. The cost of renewals under the circumstances was inconsiderable and the supply bills very small. Unfortunately the line was in operation but 3½ months of the year, but the net returns were very large.

Time and the raging sea have long since put the Marine Railway out of business, but while it existed it was a veritable gold mine.

HOSE DRAINING FOR FIRE STATIONS

By F. W. Bentley, Jr.

Laborious methods are sometimes employed to drain the hose at small fire stations before winding the hose on the reel for an emergency. The writer has seen hose pulled over rafters, shafting, and any kind of projection which would afford a means of hanging the lengths of pipe for draining the water out. The sketch and photograph are descriptive of a neat arrangement employed by the department of a small railroad shop. It makes the draining of the hose a speedy and an easy operation. The sketch shows the construction of the cradle, which can be used to pull up six lengths if necessary. The hose lengths are doubled at the center, and a long bolt slipped through them. They can then all be raised at once. When lowering them, the ends are carried out and laid flat ready to be wound on the reel, for the withdrawal of a cradle bolt is all that is necessary to free a length from the cradle.



Hose Drainer for Small Shop.

The arrangement can be inexpensively erected and its use saves a great deal of work in the very necessary operation of draining before the hose is again wound on the reel.

TO HELP AMERICAN TRADE

A notice has been issued by Mr. Willy Lamot, of Shardhighs, Halstead, Essex, England, in which it is announced that several competent Belgian business men have formed an organization in order to introduce, as soon as the European war is over, all American products and manufactures.

It is also intended to employ a large number of Belgian manufatcurers and business men, who have been partly ruined, but still possess enough capital to go on with. These men, who can give the necessary guarantees, are to act as agents, dealers, etc., in the work of introducing American products.

Those interested in this object are requested to communicate with Mr. Lamot (address above) and full details will be given to them. It is suggested that, owing to the war risk to which mail matter is subjected, when a letter is sent a duplicate be forwarded about a week later in case the first is lost.

It is hoped by the promoters of this idea that American firms may thus get in touch with the Belgian business world, by securing the services of men who are on their own soil and who are able to reach customers for American goods in the most direct way.

FAILURE OF REFRIGERATOR CAR WHEELS

According to the M. C. B. committee report on Car Wheels, there appears to be a very large percentage of failures of 625-lb. wheels under refrigerator cars. In fact, these failures appear to exceed the failures in other classes of cars. The reason appears to be that a large number of refrigerator cars have a gross weight of 105,000 lbs. or more, which produces a wheel load greater than this kind of wheel is supposed to carry. But overloading is only a part of the cause.

The 625-lb. wheel failures are more marked on roads having long and heavy grades, and the cracking and breaking of wheel plates is believed to be the result of the heating of the wheel, due to long and continuous brake application.

According to present practice, cars are braked to 60 per cent. of their light weight, based upon 50-lb. pressure. The result of this is that a refrigerator car of 60,000-lb. capacity, weighing 44,000 lbs., equipped with 625-lb. wheels, has a braking power, in many cases, equal to or greater than a car of 100,000-lb. capacity weighing 40,000 lbs. and equipped with 725-lb. wheels.

FACTS ON FRICTION.

Some interesting facts concerning Friction are briefly touched on in the report of the M. C. B. committee on "Brake Shoe and Brake Beam Equipment." These are as set forth:

1. It is apparent from information given as a diagram in the report that the coefficient of friction diminishes as the pressure on the shoe is increased, but that for pressures from 12,000 to 18,000 lbs., inclusive, the difference is slight. It is furthermore apparent that pressures in excess of 18,000 lbs. are not economical.

2. Reference to another diagram shows that the coefficient of friction at high speeds is very much less than at moderate speeds, the average coefficient at 80 miles per hour being less than 10 per cent. or less than one-half the corresponding average at 40 miles per hour.

3. The coefficient of friction of filled or composition shoes is in all cases considerably greater than the average for the other groups mentioned being from 50 to 100 per cent. in excess.

4. It is apparent from diagrams that general conclusions can not safely be drawn as to the effect of speed and pressure on the loss of weight, except that pressures in excess of 18.000 lbs. cause an abnormal loss.

New Steel Car With Many Novel Features

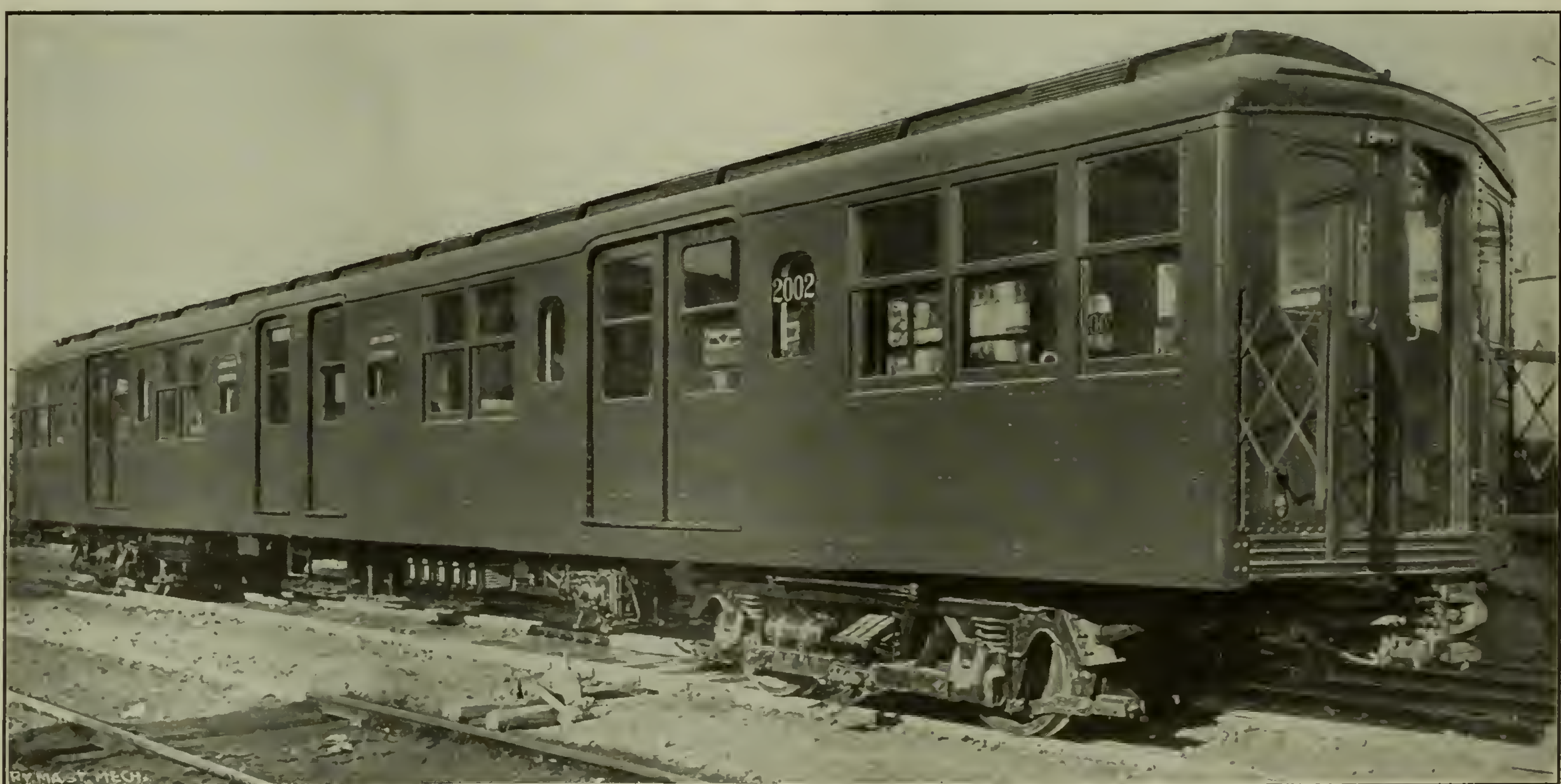
When the design of the cars for the New York Municipal Railway Corporation came to be considered, it fell to the lot of Mr. W. E. Johnson, the engineer of construction for the road, to do the work. The design brought out is different from the usual subway car construction in several important particulars. The cars are, of course, all steel, and have approximately a greater capacity than cars previously used, and this advantage is secured without increasing the axle load. The maximum weight of car was determined by the capacity of the bridges on the road.

Each car used by this road is a motor car, which is a decided advantage from an operating standpoint. The trucks are equally loaded, and the distribution of weight on each truck was arranged so as to permit a motor to be placed on the inside axle, so that the motors faced the center of the car, and this simplified the arrangement of motor leads and provided room for the draw gear. The truck bolsters are spaced so as to put greater weight on the outside axles, in order to compensate for the weight of the motors. An unequal spacing of the helical springs on the truck equalizers also helps in this direction.

The Municipal Corporation cars have a very satisfactory seating capacity. The cars are longer than those used in the New York subway, so that eight cars of the former equal ten cars of the latter, so that, car for car, it is obvious that the floor space in the new cars is the greater, carrying 150 persons as against 120 in New York. Of the 150 persons, 78 are provided with seats and 72 have to stand. These persons have on an average 4¼ sq. ft. each. The larger car has an economical edvantage in the fact that it has no more equipment parts than the smaller car.

The interior of the car provides a liberal supply of transverse seats, which are generally more popular than the longitudinal. The cross seats are so placed as to practically divide the car into three compartments, with a pair of side doors communicating with the platforms for each of the compartments. Folding seats are provided to drop down opposite one-half of each of the double side doors. When used for light traffic they provide seats for 12 persons, and these, added to the rush-hour seats, make the total 90. The doors used for passage in and out are, of course, in a definite place, and in the non-rush hours half of the double door is used, and the whole double door is used in the rush hours. This means that an exit either large or small is always provided at the same place in the car, and no confusion can take place, as may occur when the points of ingress or egress are altered from time to time.

The folding seats have a self-contained pedestal on one end, which folds down automatically when the seat is lowered; the other end is hinge-supported. A self-locking latch is provided for holding the folding seat when not in use. The six side doors in each car are spaced so as to reduce the average walking distance in entering and leaving, thus saving time in loading and unloading. The doors are controlled by a trainman stationed at approximately the center of the car, thus giving him a view of what goes on. Each door is moved by the action of a double-acting air cylinder, directly connected with a bracket on the door, the air being controlled through one electro-pneumatic valve for each pair of side doors and one valve for each end door. The doors are operated by push-buttons on the piller which stands between the halves of the center doors; pressing one button opens all the available doors on one side. A distinct button is provided for the closing of each door separately. When a folding seat in put in use, the act of letting it down automatically cuts off the air from its operating cylinder and a mechanical latch holds it so that it cannot be opened. A signal circuit is arranged so that the closing of the doors makes electrical connection with the cab, and the closing of the last door completes the final link in the



New All-Steel Passenger Coach New York Municipal Railway Corporation.

chain and the starting lamp glows before the motorman. Buzzer circuits are also provided in case of emergency.

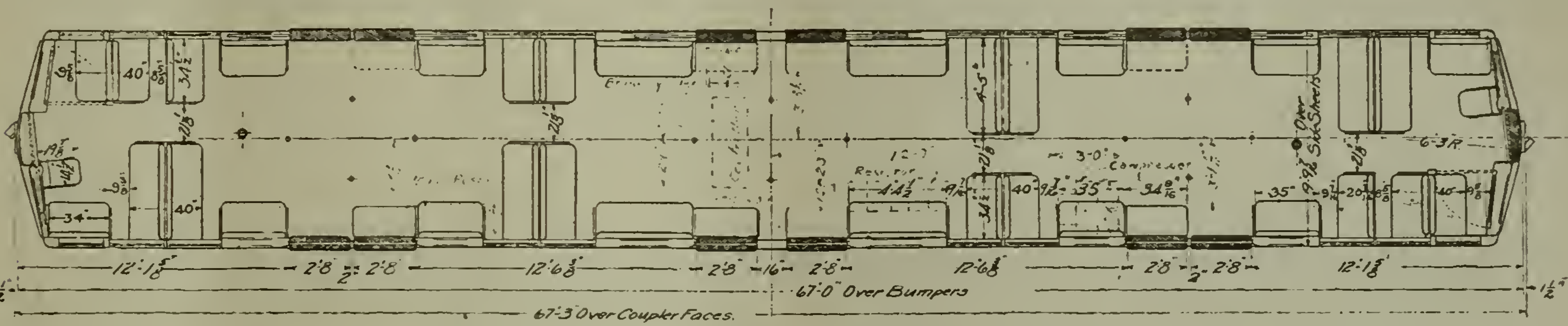
The lighting system contains fifteen 56-watt Mazda lamps; thirteen of them are in a single row in the center of the car, and one on each bulkhead deck. The total light is represented by 840 watts. An emergency system of six 10-watt, 34-volt lamps, one between each pair of side doors, is provided. These lamps light whenever the shoes do not make contact with the third rail or when the power is off. These lamps are operated by a storage battery and they will only burn when the power is off the car, and in that case they go on automatically.

One striking feature of the coupling arrangement is that it does away with connections formerly made by hand. These are air, electric, safety gate, chain, etc. All the necessary connections are made when the cars are pushed together and coupled up. Further than this, the front lights and the tail lamps automatically light up and show the correct colors on the front and rear of the train, and at the same time similar lamps on each end ot the intermediate cars are cut out and do not light up. This takes place without requiring attention by those handling the cars.

The brake used is the Westinghouse electro-pneumatic system, and the rigging is designed to give 90 per cent. of car weight on the outside wheels and 110 per cent. of that on the motor or driving wheels, under 50 lbs. pressure for service application. A novel adaptation of the light and load brake has been made on these cars. An attachment operated by the movement of the truck eliptic springs governs the light or load feature, as the car becomes full or loses passengers. This device is only effective when the car is standing at the platform. An influx of passengers produces greater weight and the attachment provides for increased brake power. If enough passengers leave, the load becomes lighter, and the brake power is correspondingly reduced. This action of the truck eliptic springs takes place only at stations and when the doors are open; but when the car is running it is inoperative, so that the vibration and the deflections caused by the motion of the car produce no effect on the brakes. The clasp brakes used—i. e., two shoes to one wheel—produce an average rate of retardation for service stop from 50 m. p. h., is about 2 m. p. h. per second, and an emergency application gives 3 m. p. h. per second.

The motive power is supplied on each car through two G. E. type 248-A interpole field-control motors, having a normal rating of 140 h. p. each at 600 volts, controlled with Westinghouse "bridge" type A. B. F. electro-pneumatic multiple unit control. The speed obtained in local service is about 15 m. p. h. and 25 m. p. h. for express. A simple but effective device is provided for automatically regulating the current input so as to obtain a uniform acceleration regardless of passenger load. The device is similar in function to the "empty-and-load" brake appliance. Whether the car is light or becomes heavy with the influx of passengers, the rate of acceleration remains the same. Auxiliary circuits for brakes, tail lights, car signals, doors, marker and emergency lights, etc., are supplied from Edison type B1-H, 34-volt storage battery.

The cars are made of steel throughout, with a magnesite cement floor. A 2½-inch high cove is made wherever the floor intersects with seat pedestals. This curve is placed at side and end walls and all corners are likewise curved, so as to avoid places where dust and dirt can lodge. All railings and hand-holds are white porcelain enamel, and four upright staunchions opposite the doors are finished in the same way, and provide convenient and satisfactory support for standing passengers. The whole interior is hard enamel, and the car is not only light and clean, but it can easily be kept so by thorough washing or flushing out. Olive green, used below the windows and for seat frames and doors, add to the good qualities of the interior finish and produces a pleasing effect.



Floor Plan of New Municipal Subway Car—Showing Arrangement of Seats.

Interior View, Showing Arrangement of Seats.

THE MISSISSIPPI EASTERN RY. has one Baldwin 45-ton consolidation locomotive for sale.

HOOSACK TUNNEL AND WILMINGTON R. R., Treas. L. M. Kallis, Malone, New York, have for sale narrow gauge engines and cars.

THE LITTLE ROCK, MAUMELLE AND WESTERN R. R., Mgr. F. Niemier, Little Rock, Ark., is in the market for twenty-five logging cars and has one locomotive for saie.

GOULD SOUTHWESTERN RY., Rec. W. H. Roberts, Gould, Ark., are in the market for one new locomotive, one combined railroad ditcher and steam shovel. This road has for sale two locomotives.

A Study of the Railroad Apprentice System

The article on this subject by A. G. Crocker, which appeared in our July number, tends to show how important this feature of the railway business is. The apprentice is the forerunner of a good mechanic, and a good mechanic will find his advancement easy toward a still higher position. Hence the need of good health and a fair education at the outset. With these fundamentals the apprentice is well equipped to undertake the profession he is to follow. All it requires after that is persistence and careful attention, even to the minutest details. Those fail in the end who neglect every opportunity to learn and who do not put forth their best efforts at all times. Now that the railroad business has become an exact science it requires efficiency always in every department, and the mechanical department is one of the most important of all. We hear a good deal in these times about efficiency. It is a watchword, and like the motto *"Safety First"* it occupies an important niche in railway management. It is in seasons such as the railroads are now going through that efficiency counts for everything. Economy without stepping beyond reasonable limits is the need of the hour in railway operations. This means efficiency. A good apprentice can be of as much service in his way in this direction as any other employee. Once he feels that much depends upon him he is bound to exercise all the care and ingenuity he possesses. It is an old saying that *"there is always room at the top."* Every apprentice should be encouraged to feel that he is in the way of reaching that much coveted position. He cannot avoid the opportunity if he will but exert himeslf. If he becomes disinterested in his work, showing that the profession he has chosen is not suited to his taste, he is wise to abandon it forthwith. He does himself a good turn and his employer as well. His prompt decision may drive him into some other field where success awaits him. He does not require advice to act; his judgment governs. It is interesting to note that so much attention is now being paid to this matter of apprentices by the railroads. It is fundamental.

In addition to the lines reporting their methods, in this direction, we find among others that the Oregon Short Line employs 74 apprentices. The age limit in all departments except the blacksmith shop is 16 to 21 years. The apprentices in the blacksmith shop are taken from helpers who have had at least one year's service in the company in that capacity and are allowed to continue at the helper's rate during the first year of their apprenticeship, and no age limit is observed. Apprentices must be able to read and write and do simple problems in arithmetic. They must pass a satisfactory medical examination before the company's physician. They are under probation for one year. They are not given any educational advantages at present.

There is one apprentice instructor, but there is no apprentice school at present. Four years is the duration of the apprenticeship.

Machinist apprentices are given two years on machines, divided into three month periods on each of the principal machines, unless they show exceptional ability, when they are advanced more rapidly; two years on erecting floor and in air room, divided into three months on shoes and wedges, six months on valves and motion work, three months boring cylinders and valve chambers, three months on general work, three months on cabs and steam pipes, and three months in air brake room.

Boilermaker apprentices are advanced from heating rivets to light riveting and caulking, then to heavier boiler work, two to three months with layer-out, finishing up with general work and roundhouse repair work.

Electrical apprentices are advanced at the discretion of their foreman. Their work consists of repairs to locomotive lighting equipment, shop equipment, and car lighting.

Blacksmith apprentices advanced from helpers are given a fire without a helper, and advanced as they show proficiency.

Pipe fitter and tinsmith apprentices are given work in all grades of pipe and jacket work as they show proficiency.

Most of those who leave do so in their preparatory year, because they feel unfitted for the work, or to seek more remunerative employment.

All graduates are urged to remain in the service, their advancement depending on the man's ability and the interest taken in his work.

No bonuses are offered to complete the apprenticeship.

Results are generally satisfactory.

From a commercial viewpoint the apprentice courses have proved to be of commercial benefit.

An accurate record is kept of each apprentice's work and advancement and the time spent on each job or machine.

More rapid advancement is the reward for high standing.

A diploma is given at the completion of the apprenticeship.

Since the apprenticeship system has been established, the number of apprentices employed has increased in all departments from 28 to 74, the number of machinist apprentices increasing from 18 to 58.

Special Apprentices.

At present we have no special apprentices, except those in the blacksmith shop, who are advanced from helper.

The Chicago & North Western Railway Co. furnishes a report based upon data prepared at its Chicago shops. The custom there prevails in all its shops.

Machinist apprentices	69
Boilermaker apprentices	10
Blacksmith apprentices	5
Total number of apprentices	84

16 to 21 years is the age limit.

Machinist apprentice must have certificate of graduation from grammar school.

Officer in charge looks after this when the boy fills out his application.

The first year is a probationary period.

Arrangements are made with Crane Technical High School, Chicago, for night classes, which are attended five nights per week during the terms. The machinist apprentices are given four months of their apprenticeship in drawing office.

In addition, there is an apprentice club which meets twice a month, in the evening. Papers are written and read by apprentices. Problems discussed and points of general interest to locomotive men are looked into. These meetings have been very successful and interesting to the boys, due to the fact that before reading the paper of the evening an address has been given by some officer in charge or from some invited guest who is interested in the locomotive problems of the day.

There are no apprentice school instructors.

There are two apprentice shop instructors.

Ten hours per week in night school is required.

They are not paid for the time spent in night school.

In the night school mechanical drawing, mathematics and free hand drawing are the studies generally selected, but the boys have a regular high school course to select from.

Four years of 290 days each constitute the duration of the apprenticeship.

The time is segregated as follows:

Various machines	16 months
Bench work	8 months
Drawing room	4 months
Laying out	4 months
Test work	4 months
Erecting floor	12 months
Total	48 months

90 per cent. of the apprentices complete the course. The balance of them leave because the work is too heavy.

About 90 per cent. remain in the service.

About 10 per cent. are advanced to higher positions.

As soon as they have graduated they receive the standard rate of pay and are promoted to positions of trust as fast as these become available.

No bonuses are offered.

Results obtained are generally satisfactory, and from a commercial standpoint results are also satisfactory.

The boys' record is kept on a file card in the superintendent of shops' office. The chief apprentice instructor also keeps a record of each boy.

Prizes are given for the best standing in studies at night school, also for attendance.

A diploma is given on the completion of the course.

One apprentice for each shop and one for each five journeymen is the rule, so that the increase depends on the number of additional journeymen, which has been none in the past year.

There are no special apprentices at the present time.

THE TRAVELING ENGINEERS' ASSOCIATION.

The twenty-third annual convention of the Traveling Engineers' Association will be held at the Hotel Sherman, Chicago, September 7, 8, 9 and 10, 1915. The opening session will begin at 10 a. m. Tuesday, the 7th.

A number of important subjects are coming up for consideration. Tuesday: "What Effect Does the Mechanical Placing of Fuel in Fire-Boxes and the Lubricating of Locomitives have on Cost of Operation?" "Recommended Practices for the Employment and Training of New Men for Firemen." Wednesday: "The Advantages of the Use of Superheaters, Brick Arches and Other Modern Appliances on Large Engines, Especially Those of the Mallet Type"; "How Can the Road Foreman of Engines Improve the Handling of the Air Brakes on Our Modern Trains?" Thursday: "Difficulties Accompanying Prevention of Dense Black Smoke and Its Relation to Cost of Fuel and Locomotive Repairs"; "The Electro-Pneumatic Brake." Friday: "The Effect of Properly Designed Valve Gear on Locomotive Fuel Economy and Operating"; "Scientific Train Loading—Tonnage Rating—The Best Method to Obtain Maximum Tonnage Haul for the Engine Over the Entire Division, Taking into Consideration the Grades at Different Points on the Division."

If any further information is desired it may be obtained by addressing the secretary, Mr. W. O. Thompson, care of the New York Central Car Shops, East Buffalo, N. Y.

LAWS OF FRICTION APPLIED TO BRAKES

If Moran's laws of friction had not long ago been discredited, the work of the M. C. B. committee on Train Brake and Signal Equipment would have easily accomplished the overthrow of those so-called laws.

In the recommendation made concerning "clasp truck brakes for passenger cars," the committee point out that the clasp brake (that is, two brake shoes to each wheel) has been found to be beneficial in reducing hot boxes in so far as brake action may be responsible for it. The clasp brake does not tend to disturb the position of the journal with reference to the brass as one brake shoe might do, when applied vigorously to one side of a wheel.

The clasp brake has a tendency to reduce brake shoe consumption for a given number of foot-pounds of brake work done, and to produce a smoother stop than that made by the single shoe. In other words, the clasp brake is conducive to the comfort of the passengers, and judged by the amount of brake work, in foot-pounds, it is more economical for the railroads. This economy is also extended to renewal of brake rigging parts.

The stopping efficiency is given at twenty per cent. greater than that with the single shoe equipment. One of Moran's "laws" stated that the amount of friction was independent of the areas in contact, and here the modern view shows that twice the area in contact produces twenty per cent. greater efficiency. The rolling friction of wheel on rail causes the wheel to turn as the car progresses along the track; and 50 ft. of track is covered by 50 ft. of whirling tread of wheel. If by the application of suitable means one can produce a tendency of the wheel to measure out less than 50 ft. of tire for 50 ft. of track, then brake action has begun. If the clasp brake increases the tendency of the wheel to give still less tread for a given length of rail the brake action is by that amount more efficient. More force is developed to make the wheel give the requisite 50 ft. of tread to 50 ft. of track. The wheel must not slip or slide or the retarding force of the brake would decrease. It must give 50 ft. for 50 ft. of track and brake action makes it harder. The committee suggest the use of the clasp brake for wheel loads of 12,000 lbs. It also recommends the use of truck clasp brakes for 4-wheel passenger trucks on coaches weighing 96,000 lbs. or over, and on all 6-wheel trucks under cars of 136,000 lbs. weight.

Some years ago the Westinghouse-Galton tests established the fact that a brake shoe pressure competent to "skid" a slowly revolving wheel could be safely applied to a rapidly moving wheel for a time. The high-speed brake, therefore, became a possibility, and another of Moran's "laws" went by the board.

In the matter of hand brakes for heavy passenger cars, the committee pointed out that the difficulty in the hand brake problem arises from the fact that the great weight of the cars nowadays is such that an ordinary man has not the strength necessary to efficiently apply the hand brake, unless he is provided with such a system of levers as to make the whole apparatus cumbersome.

The committee outlines the requirements of the case by suggesting that hand brakes for modern heavy passenger coaches be designed so that the hand brake action will be concentrated on one truck, and they further suggest that whatever method is devised, it shall be capable of taking up the slack in the brake rigging quite rapidly with low power leverage, and when the slack is all in a high lever power be at once brought into action for the serious work of efficiently applying the brake by the man operating it.

DESIGN AND INSPECTION OF BOILERS

In the discussion of the report on design, construction and inspection of locomotive boilers, which was presented by Mr. C. E. Fuller, of the Union Pacific, as chairman of the M. M. Convention, a most interesting and instructive side light was thrown on the action of staybolts in a boiler, fired up and heated to the blowing off point.

Mr. George L. Fowler stated the results of some tests he had made on two boilers. The investigations gave results which he thought could only be taken tentatively, but they were at least indications of what goes on in the fire box.

The object of his experiments was to determine as far as possible the amount of movement between the sheets forming the side leg, so that the bending of the staybolts might be determined. Two boilers were tried on the N. Y. C., one with rigid staybolts and the other with Tate flexible bolts.

With appropriate apparatus, designed by himself, Mr. Fowler used a beam of light which, being reflected from a small mirror on the sheet, multiplied its movement. The boiler carried 200 lbs., raised in from 55 min. to 1½ hours, the pressure was held for 15 min., after which the fire was dumped and the steam blown off. Taking the upper front corner, the boiler with the flexible bolts showed a movement of .031 in., and with rigid stays .013. At the top back stay the movement was backward about the same in amount. The middle stay was found to vary from front to back and up and down all the time. The rigidly stayed boiler showed about .026 in. as against .042 in. for the flexibly stayed boiler.

A fair average may be stated as twice the amount of movement for a flexibly stayed boiler as for that of a rigidly stayed one. As far as the experiments were made they determined that the staybolt is in constant motion while the boiler is hot. It is always bent while it is under stress, and the maximum deflection takes place before the finger of the steam gauge moves. The relative movement of crown and roof sheets was investigated. As soon as the fire was started, the crown sheet began to move up relatively to the roof sheet. When the pressure began to show on the steam gauge, the crown sheet dropped and continued to drop, generally below its normal position when full pressure was on.

An attempt was made to get the relative movement of the back tube sheet to the shell. As soon as the fire was started the tube began to move back. It moved the sheet back with it at first and later the sheet adjusted itself, showing that the original backward movement was due to the direct thrust of the tube. In the tube sheet and back sheet test, the fire was kept up with throttle open. When getting up steam the movement of the tube was steady, but increased rapidly when the throttle was opened, when it became very rapid. It moved 50 per cent. further with throttle open than while getting up steam.

In the matter of temperatures Mr. Fowler found that over the top of the arch the temperature of the waterside was a little above the water temperature. On the other side it was about 750 deg. F. In experimenting at the end of the firebox, and when getting up steam, conditions were normal. The smoke holes in the side sheets were found to cool the sheets locally by the inflow of cold air, and had to be plugged up temporarily. When the apparatus was placed back of the fire door, it was possible to tell at once when the door was opened, owing to the cooling of the sheets. The cold air entering the smoke holes chilling the sheets explains the cracking of the sheets near these apertures, and the effect of opening the fire-door is a good argument for mechanical stokers.

LOCOMOTIVE COUNTERBALANCING

The report on locomotive counterbalancing was presented by the chairman, Mr. S. G. Thomson, superintendent of motive power and rolling equipment of the Philadelphia & Reading Railway.

During the discussion Mr. M. H. Haig (A., T. & S. F.) said that a large amount of the matter in the report dealt with the reduction of weight of reciprocating parts. Continuing he said: If we can get material which will justify this reduction it will then be practicable to design these parts of smaller size; but to do this so as to prevent engine failures requires a very high quality of dúrable material. Regarding the engines of 1914 with light parts, some of them have had their parts break, and it would be interesting to know the extent of these failures, and how they compare with other locomotives. Many locomotives counterbalanced by the builders have had the work done again after coming on the road. He had known engines counterbalanced on the two-thirds method to be better after having been re-counterbalanced according to that rule.

Mr. C. D. Young (P. R. R.) stated that on the road he is connected with. many locomotives, of the high speed passenger type, have hollow piston rods, hollow crank pins, with valve gear lever attached directly to the crank pin, and light electric cast steel crossheads. These engines have been in service two years without broken parts. It seemed to be advisable to "heat-treat" the reciprocating parts. The lightening of parts is of advantage, and members can safely lighten up many parts if the material is carefully inspected when being treated.

Mr. J. E. Pilcher (N. & W.) recalled an investigation he made some years ago of an engine with heavy reciprocating parts which gave a bad knock. Indicator diagrams were taken and the piston load curve plotted. At a definite speed it was found that the piston pulled the reciprocating parts for 3 ins. at the beginning of the stroke. This is an example of the possible effect of heavy reciprocating parts.

Mr. S. G. Thompson (P. & R.) pointed out that any type of locomotive could be designed without spending much money in refinements, and stick to 1/180th part of the locomotive for total weight of parts. The committee had made it 1/160th to be conservative and to represent average conditions. The figures vary on freight engines built before and after 1904. Anybody building a freight engine with 1/134, as the proportion of parts to total weight, is going to have trouble, no matter how it is counterbalanced. When the fraction is 1/240, high grade, heat treated material must be used to produce the heat designs. This can be done profitably.

The contention of not being able to get results with heat-treated steel and the refinement of design for less weight, he thought ought not to be considered. If weights of reciprocating parts are too light, the engine will ride roughly, and high speed will make it worse. Pre-admission and cushioning are also pertinent matters in this connection. It all comes back to the importance of making the reciprocating parts light in weight.

A PRACTICAL IDEA.

By William H. Wolfgang.

In typewriting data sheets on standard 8½ x 11 bond paper, I have found by using black carbon paper with the emulsion side against the bond sheet, that this makes a better data sheet which will not rub off, and very good readable blueprints can be made therefrom.

This is also advisable in writing specifications and parts lists on bond paper instead of tracing cloth where numerous prints have to be made.

Constructional Advantages of Foster Superheater

Practically everyone realizes the efficacy of the superheater. It is a coal saver and economizer of water consumption. The superheater is a most practical application of a correct engineering principle, and it does valuable work, yet objection to its adoption in some quarters has arisen from the fact that many persons considered it as a rather complicated method of transferring boiler troubles to superheater troubles, and that an engine is often out of service, owing to superheater troubles, almost enough to discount the advantages otherwise obtained.

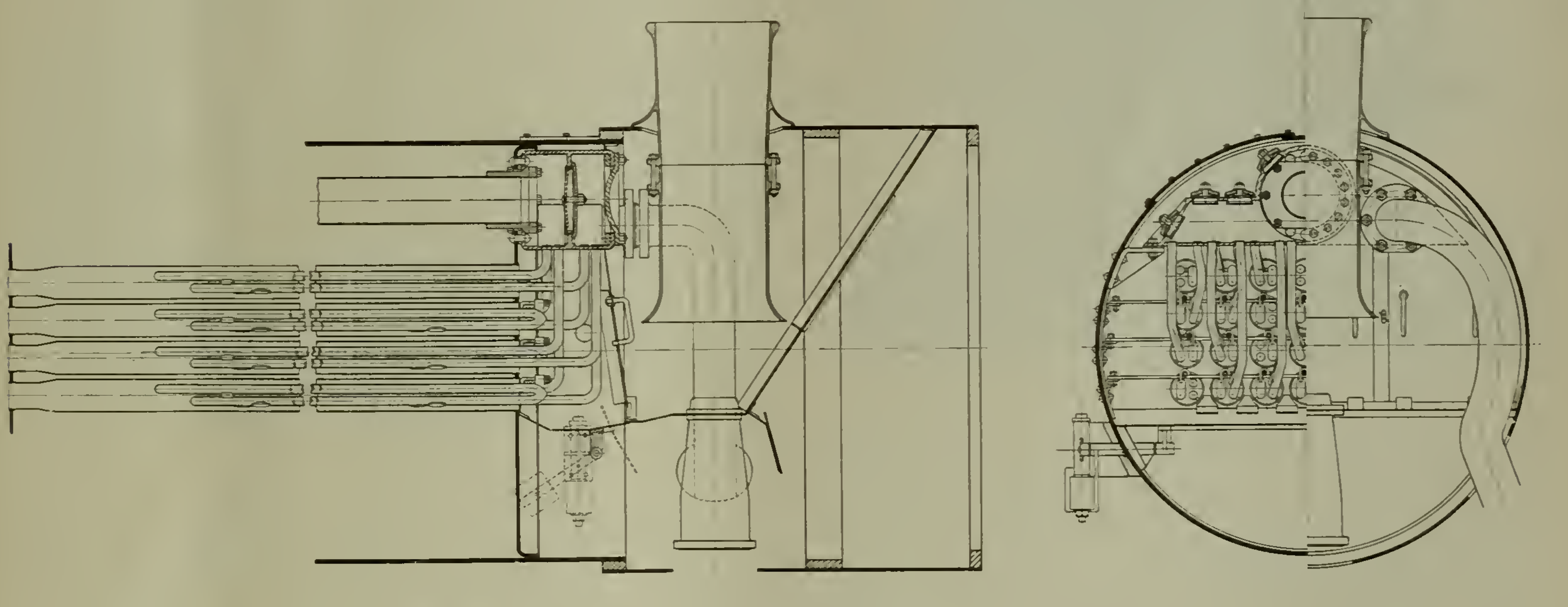
There has undoubtedly been something in this contention; and among the workers toward simplicity of construction, one may mention the Power Specialty Company of 111 Broadway, New York, who have brought the Foster Locomotive Superheater to a high point of structural efficiency.

This boiler has, for example, twenty-eight flues in which the superheater pipes are placed. These are made of boiler tube steel and are bent over, at their ends, in an easy curve, like a hair-pin. The return bends are formed by bending the tubing through 180 degs. and cutting a section out of the middle of the curved portion. The ends are then butted together and welded. Such bends have stood pressures exceeding 5,000 lbs. without failure. This gives the bend an outline like the prow of a boat, and offers practically a stream line path for the hot gases coming from the firebox. On the bottom of the units and between the superheater pipes themselves, small lugs are electrically welded and these keep the elements in place and properly supported.

The units, in sets of four, run each, where they emerge from the flue, turn up, with easy curves to the header. One unit end comes down from the saturated steam header next the flue sheet, and the other turns up to the superheated header which is placed in front. The superheater pipes, where they enter or come from, the headers are held in place by being roller expanded, without beading, belling, grooving, or other deformation. They are simply straight rolled into the header and they will hold more than 1,000 lbs.

The units are sustained on small legs in the flues, and are expanded into the headers, but that is not all. They are secured in place so that the joint cannot be subjected to momentum thrusts. Above each set of flues a bar of flat iron is placed. It is secured at each end to the smoke box walls, and each unit is supplied with a hook-bolt, nut, and clip. One end of the bolt hooks over the anchoring bar of flat iron. It does not require a very strong flight of the imagination to see what a practical assistance this arrangement is, in withstanding the service shocks of every day work, as when the engine makes a jerky start, or receives a sudden check in moving quickly up to a string of loaded cars.

The units are held at both ends and strongly tied in the middle, but anyone of them is separately "get-at-able." In the first place the smoke box, back of the stack, is cut away so as to give access to the header. The opening is closed by a cover-plate secured with bolts. When this plate is off the header is seen to contain a number of hand-holes, one for each connected unit. These hand-holes are, paradoxical as it may seem, closed with a plug too small for the hole. Let us here say that a piston is too small for its cylinder, and a spindle is too small for its gland. The plug we speak of, by being too small for the hand-hole, permits of its being put in from the outside. Around the "too-small" plug, a cylindrical band of copper is placed and the whole is tightened up by a central bolt and nut, as hand-hole stoppers are usually tightened. The plug tightens on the band. This arrangement permits the superheater pipes to be rolled or expanded into the header. If they become leaky they can be got at without any unnecessary removal of parts not otherwise affected. When it comes to taking out one of these expanded superheater tubes, the ends do not have to be cut or deformed in any way. They are simply knocked or backed out with a hammer, and are good for service again.

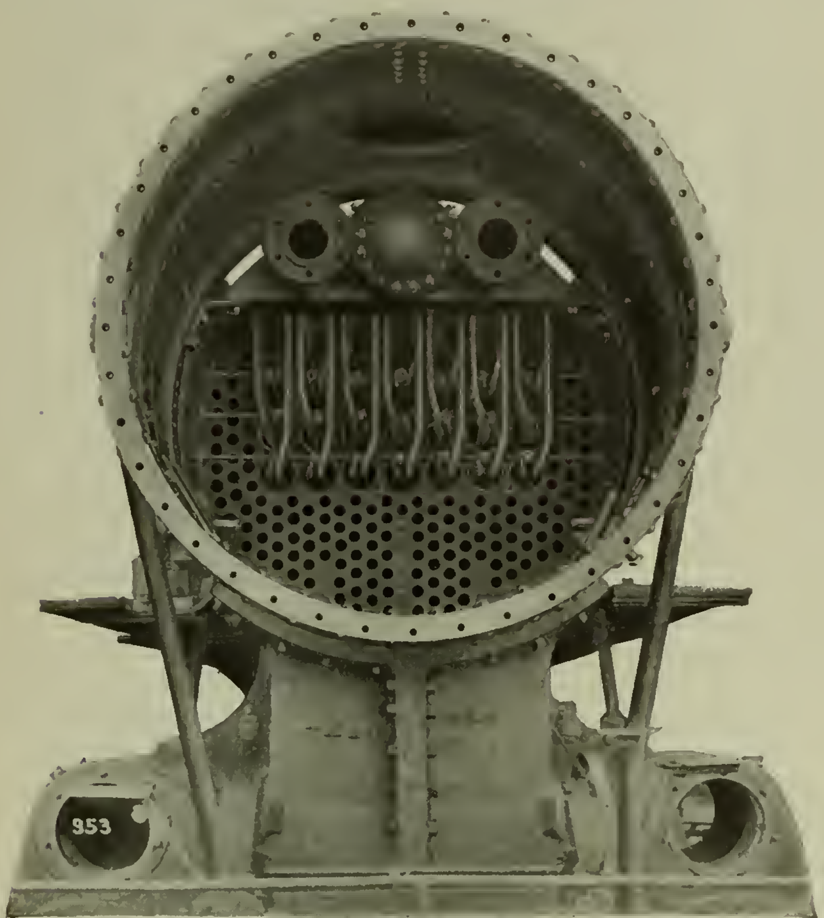


Side and Front Views of the Foster Superheater for Locomotives.

Thus far it is very evident that facility for repairs has been uppermost in the minds of those who have improved and are handling what was formerly called the Young superheater. The principle that if a foundation stone in a building crumbles, it is not necessary to take down the whole house, has been most successfully ap-

plied to this useful feature of locomotive construction. With some forms of superheater the removal of the dry pipe occupies upwards of 50 hours. In the Foster arrangement the centre of the header is a large circular chamber from which the horizontal header arms extend. These horizontal headers are flattened pipes and receive the superheater elements and are under the smoke-box cover-plates. The large central circular chamber, made of steel tube material, has a cover or head, bolted to it opposite the opening for withdrawing the dry pipe. The opening between the saturated steam and the superheated steam action is closed by a plug and copper gasket similar to, but larger than the hand-hole plugs in the header. If the dry pipe leaks, it alone receives the attention of the repairman, and the rest of the superheater apparatus is not disturbed.

The damper apparatus is simplicity itself, and consists of a one-piece casting which contains cylinder and bracket together, so that there is only one set of bolts used to hold it in place. The cylinder is piped to the



Front View of Superheater, Showing Cross-Header.

valve chamber, and when steam is used, the damper-piston rises and opens a damper so that the hot gases from the fire-box may pass through the flues and give up the heat that raises the temperature of the steam. When steam is shut off the piston sinks down, the action being rendered positive by the power of a gravity counterweight. Levers, bars, and joints are dispensed with, and there is but one pivot, lever and spindle to do the work. When the damper is closed the whole of the superheating apparatus lies in dead, inert gas which does not flow through the flues. The ordinary tubes, however, provide an adequate passageway for the gases, in case the engine is standing shut off, or if the engine is being fired up.

The method of applying the dry pipe joint to the front flue sheet is simple, and there is now no re-inforcing ring inside the flue sheet. The present method consists in welding a ring made of boiler plate to the back surface of the header where it touches the flue sheet. Through rivets hold the header and tube sheet together so that when in place, the header and sheet are closely connected and the header practically becomes a permanent part of the flue sheet. The ground joint of the dry pipe is made inside the header and at a place where it is backed with the reinforcing ring. As the dry pipe can be removed without taking down the header, this joint is always accessible, and does not require any more time to make it, than if the superheater was not there. The lighter steel header which is now used, is less liable to fail by cracking than was the heavy type of cast header.

The advantages of the superheater in locomotive practise are well known. By heating saturated steam, additional heat units are given to it, by which it may withstand a certain amount of heat loss when it strikes the comparatively cool cylinder walls without turning into water. With the same pressure, it reaches the piston at greater velocity than saturated steam does, and therefore, if one may say so, strikes a harder blow. The less condensation insures a reduction in the water which must be evaporated, and this is gained without extra coal consumption by the utilization of heat which would otherwise go to waste. It is in short the turning of high pressure fog into an almost perfect gas.

The work of upkeep for this most useful apparatus, has been closely scrutinized by the designers of the Foster superheater, who had an excellent foundation to build on. They have succeeded in practically eliminating all the costly work of taking down and putting back good apparatus, simply to reach a defective part. Their material and design have reduced the liability to failure, and done away with ground joints. The whole plan is one that bears evidence of careful attention to detail, intelligent and productive study of design, and practical adaptation of means to an end which has produced a serviceable and highly economical result.

B. & O. VETERANS' OUTING

The first annual outing of the Veterans' Association of the Baltimore and Ohio Railroad was held at Berkeley Springs, W. Va., August 12. The event was a memorable occasion for the employes of the company who have been in the service twenty years, as well as for their families and friends. Invitations were sent personally to the hundreds of old railroad men who have served a score of years, and invitations were extended to executive officials and others to take part in the reunion. Mr. Z. T. Brantner, president of the association and a veteran holder of a gold medal for fifty years' service, who is superintendent of shops at Martinsburg, W. Va., had charge of the celebration for the Cumberland division veterans who were the hosts.

Mr. Brantner's railroad service goes back to civil war days, and many are the war stories told among comrades of the Baltimore and Ohio Grand Army Club of the Rail as they recall the days when they were operating the railroad under the direction of one army and then the other, and trying to keep the property intact for the stockholders.

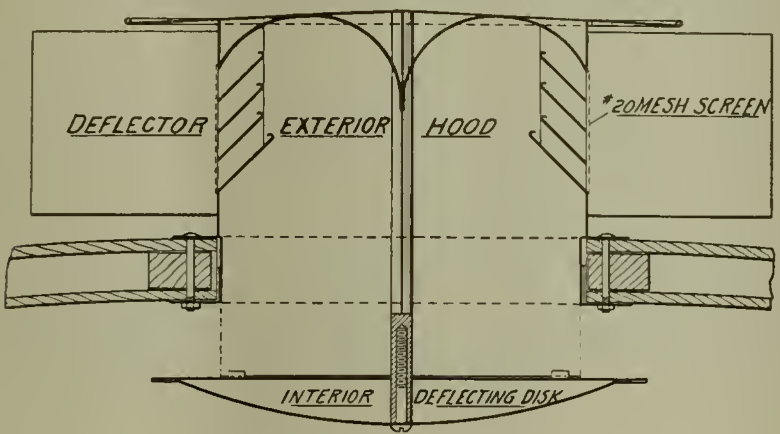
The first reunion at Berkeley Springs brought veteran employes of the Baltimore and Ohio together from all parts of the system. The Veteran Employes' Association has social and fraternal features, the membership including men of every grade of employment and from all branches of the railroad. A local branch of the association is organized at each of the division headquarters.

The Roberts & Schaefer Company, Chicago, is building two 200-ton capacity modern automatic locomotive coaling plants for the Canadian Northern, to be installed at Big Valley, Alta., and at Kindersley, Sask.

VENTILATOR FOR "ARCHED-ROOF" CARS

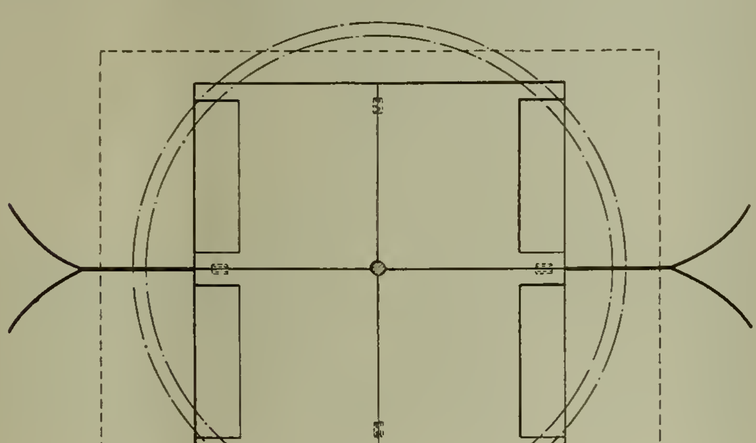
By Wm. J. Fleming Jr.

In the earlier days of steam railroading an attempt was made to eliminate the "monitor-deck" and to substitute therefor the arched-roof or "turtle-back" car, the latter construction being stronger and lighter as well as more economical to construct and maintain. Despite these advantages, however, the "turtle-back" failed to win complete approval, because it seemed to be quite impossible to adequately ventilate this type of car by any method then known. Exhausting devices of various types, and up to forty per car, were tried, but as no provision had been made for the admission of fresh air, except such as might and did leak in around the doors and windows and through the toilet plumbing, the method did not meet with general approbation, and, as a consequence, the "turtle-back" was abandoned by all but one or two of the steam railroads.



Sectional View of Ventilator.

The recent advent and growing popularity of the "arched-roof" car in electric service has brought about the development of a considerable number of ventilating devices to meet the requirements of this type of construction, several of which have apparently solved this particular problem. One of these ventilators, operating on the "intake-and-exhaust" principle, has been applied to the new steel trailer cars recently built by the Standard Steel Car Co. for a prominent Eastern railroad. This device consists of an exterior hood, divided into four compartments, with 2 ft. 6 ins. by 6 ins. openings on either side, each opening leading into a separate compartment; two exterior deflectors, one on either side of the hood, centered between two openings; and an interior deflecting disc. The ventilator is installed at the center of the "arch" and operates as follows:


Plan of Ventilator.

When the car is in motion, air is arrested by the exterior deflectors and directed into the forward compartments of the exterior hood, and thence down to the interior deflecting disc. It is then deflected outward across the upper part of the car, this deflection preventing a direct descent of the incoming cold air. Of course, the incoming air, being lower in temperature and consequently heavier than the air already in the car, descends, after losing its initial momentum, to the breathing and floor levels of the car; but in its descent it is diffused and warmed to such a degree that it does not cause perceptible draughts.

At the rear of the exterior deflector is set up a partial vacuum, caused by the rapid motion of the car, which, assisted by the air pressure within the car, induces a strong "exhaust" through the rear half of the interior disc at the two rear ports of the exterior hood. By this method a complete and well-balanced "intake" and "exhaust" ventilating system is provided.

It will be seen from the foregoing that each of the devices described is really two ventilators, although occupying but a single, small space in the car. The interior deflecting disc may also be used as the base of, or reflector for, an electric or gas light fixture. While the appearance of the "arched-roof" car is not as pleasing to the eye as that of the "monitor-deck" type (no doubt because we are not accustomed to the latter) it is quite possible that the revival of the "turtle-back" car by the electric railways, with its several advantages, will induce many steam roads in this country to return to the "arched-roof" car, if an adequate ventilating system has been devised.

COLOR OF MERCURY VAPOR ARCS.

One of the least generally understood advantages of mercury vapor arc illumination for shop work is the color of the light. A mercury vapor arc is an electrical device in which mercury in a vacuum tube is vaporized sufficiently to permit the passage of current from one end of the tube to the other forming an electric arc which gives the vapor an illuminating power.

Everyone is familiar with the result of light passing through a prism and being resolved into its constituent colors. When sunlight is so broken up, its spectrum, as the display of these colors is called, appears continuous, as a band. All the intermediate shades from red through orange to yellow, green, blue and violet appear, blending from one to the next. Such a spectrum is characteristic of the light given off by any solid conductor, and it called a band spectrum. On the other hand, light given off by the conduction of electricity through a gas does not produce all the intermediate shades of color in its spectrum nor always, in fact, all of the primary colors themselves. Such a spectrum looks as though a continuous, or band spectrum had been painted out with black until only narrow separate lines of color remain at intervals. This "line" spectrum, as it is called, indicates that the intermediate colors which do not appear are not being produced at all by the source of light. White light, which is a composite of rays of all colors, is not brought to a focus in the eye at any one distance from the lens. The red elements come to a focus farther from the lens than the blue and violet rays. The yellow and green rays come to a focus between. If the eye were to accommodate itself to the red rays, in other words, if the focus for the red rays lay on the retina, the yellow, green, blue and violet would come to a focus farther and father in front of the retina, in the order named, and would tend to blur the image. As it cannot focus all the colors at once, the eye automatically selects the green as the middle color of the spectrum and focuses for the green rays, letting the red

focus behind and the blue and violet in front of the retina. See Fig. 1.

The reader understands that there are vibrations similar to light waves beyond the ends of the spectrum, which makes no impression on the eye, and where, at the red end of the spectrum the color seems to fade out; this does not imply that the waves cease, but merely that the human eye becomes less and less sensitive to them, until they become invisible (called infra-red). At the violet end of the spectrum the effect is the same, and the visible spectrum, the part to which the eye responds,

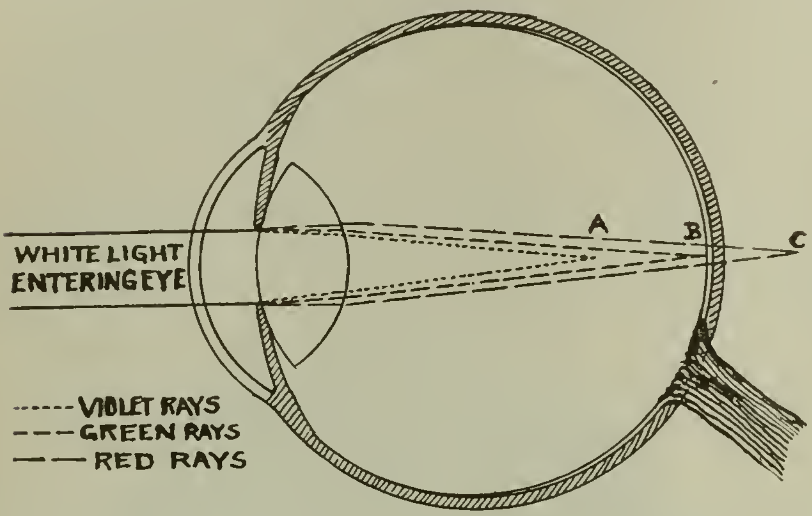


Fig. 1—Schematic Diagram of the Human Eye, Showing the Violet Rays Coming to a Focus in Front of the Retina, Under Point A, the Green Focusing on the Retina Under Point B, and the Red Behind the Retina at Point C. Of Course This Effect Has Been Greatly Exaggerated in the Diagram.

fades into the invisible ultra-violet. It follows that at the extremes of the visible spectrum, where the division comes between rays which the eye can see, and rays which it cannot, the colors on the margins do not make as much impression as those lying well within the range of vision.

The eye is less responsive to the red and violet, at opposite extremes of the visible spectrum, than to yellow and blue, as coming better within its range. Green, as the center of the visible spectrum, has the greatest visual efficiency, as the following figures, giving relative luminosity of the different colors, suggest:*

Red	12
Yellow	280
Green	1000
Blue	300
Violet	16

The most efficient light conceivable as a result of scientific research would be such that all its rays were green of the wave length 546 mu. If such a light could be generated it would require only about one one-hundredth part as much energy consumption as the common metal filament incandescent lamp to gain the same degree of visibility.

The mercury vapor arc, or Cooper Hewitt Tube, as it is commonly called, in a measure combines both of the advantages suggested. Being a gas arc, its spectrum is confined to a comparatively few lines. Nearly sixty per cent. of the light emitted from the lamp is given off by the green and yellowish-green lines. The most powerful of these coincides with the green line mentioned above as the line of maximum visible sensibility, and a second at 579 mu. is very close to this line.

This results in the light given off being of such a color as to require only about one-half the illumination to secure equal results to those given by incandescent lamps of the tungsten type. The predominance of the green rays gives the light a monochromatic or one-color character, which very materially reduces the effect of different colors being brought to a focus at different distances from the lens of the eye.

For fine work, reading scales and setting calipers, this "sharpening" of focus is of distinct advantage, though unconsciously, to mechanics in many classes of work and to the road which is paying for their time. The saving effected in illuminating expense by transforming the current used into light of maximum visual efficiency, is also desirable.

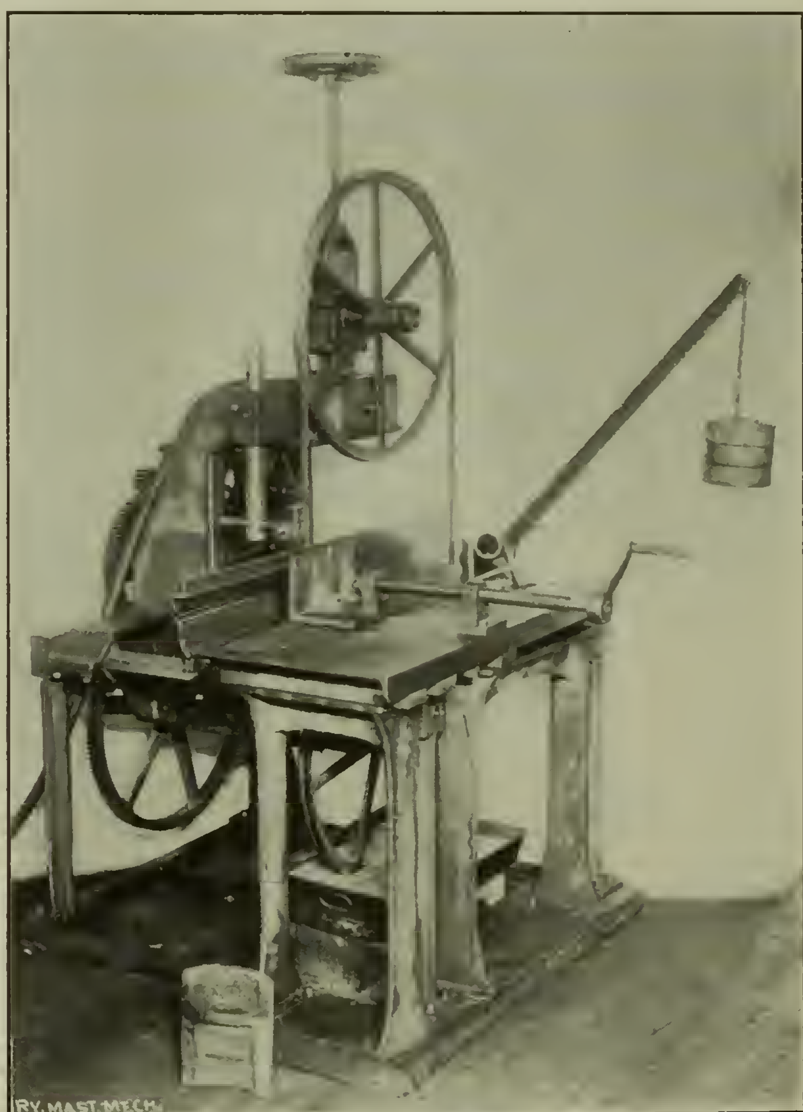
* From Ives and Lukiesh.

METAL BAND SAW

This new style metal band saw, which should be most useful in a railway repair shop, and will sell, we are informed, at a low price, is designed to cut off from 1/8 to 8 ins. round, 8-in. I-beams, or 8-in. square material. It will cut discs very true. Tubing and light material can be cut very fast. The back can be removed, thus giving a flat table for special work.

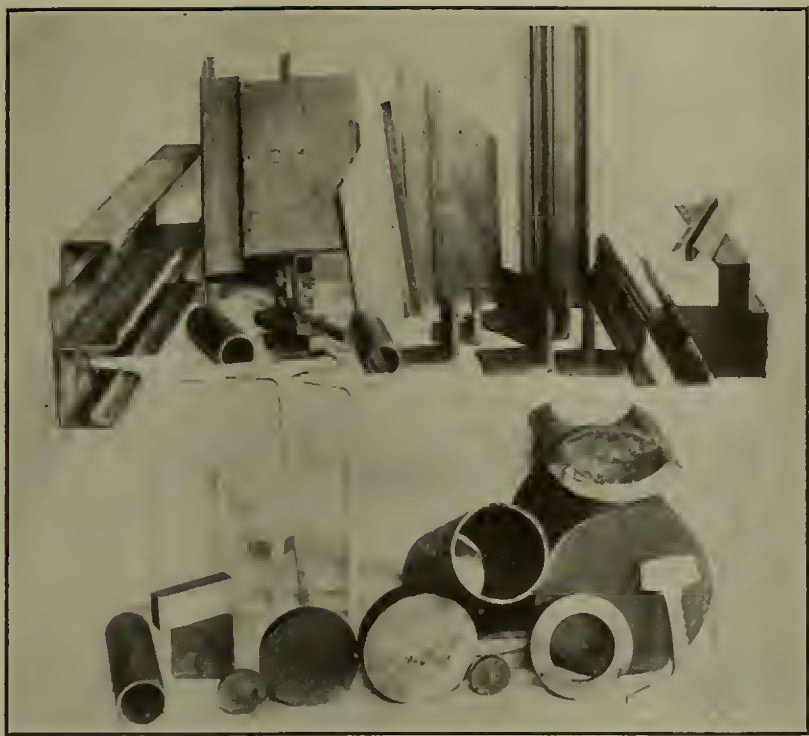
The table carrying the work is stationary, so that heavy bars do not have to be moved to the blade. The frame carrying the wheels, with saw and driving mechanism, slide on a track, as shown, and can be operated by hand or automatic gravity feed. The saw guide is conveniently located and is very easy to adjust.

The pressure can be varied by the number of weights hung on the lever. When motor drive is used the motor



Metal Band Saw for Railway Shops.

can be mounted on the frame, which is self-contained, as shown in our illustration. The tightening of the blade is accomplished by the hand wheel shown on top. It is very simple in construction, and can be operated by inexpensive labor; in fact, an operator can run several machines. The table is 26 ins. high measured from the



Examples of Material Cut by Metal Band Saw.

floor, which makes it easy to handle heavy material. This saw, however, will not cut off pieces more than 20 ins. long. It is made in Chicago, and the application of the band saw to metal work makes it "handy" in every way.

CAR INSPECTORS' CONVENTION

The secretary, Mr. Stephen Skidmore, car foreman on the C. C. C. & St. L. at Cincinnati, Ohio, has called our attention to the fact that the Chief Interchange Car Inspectors' and Car Foremen's Association was organized in 1898. Annual conventions have been held regularly since that date with increased attendance at each session.

Any person connected in an official capacity with the car department of a railroad is entitled to membership in the organization. The objects of the association are the advancement, by discussion, of knowledge relating to safe and economical railway car interchange, and to the construction and maintenance of railway cars and shops, to secure a thorough and uniform understanding of the M. C. B. rules and the general interchange situation.

The convention this year is at Murphy's Hotel, Richmond, Va., and the date is September 14, 15 and 16. Mr. F. H. Hansen, of the N. Y. C., is president, and Mr. A. Kipp of the N. Y., O. & W. is vice-president of the association.

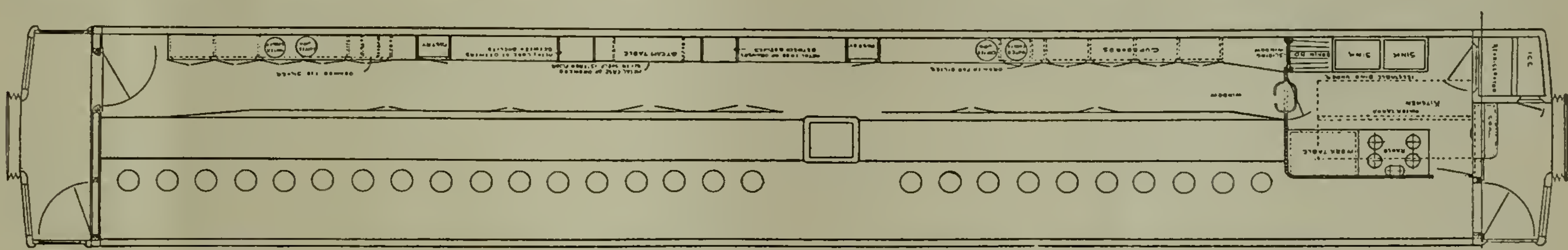
A RAILWAY GOLF LUNCHEON

What is described as a lunch car has lately been put into service on the Golf Special on the Chicago & North Western Railway. The train is intended for the convenience of golfers traveling between Chicago and Waukegan. In that distance as many as eighteen or twenty golf links are reached.

The car is layed out interiorly very much the same as the familiar lunch counter, with seats on one side of it, and a passage for attendants on the other. The golf enthusiast can leave his office about noon and be sure of a good lunch without losing any of the time that might otherwise be devoted to the game. The new lunch car is especially designed and equipped for providing quick, first class service.

A lunch, especially adapted to the tastes of patrons of this train stands ready to serve, twenty minutes before the train leaves the terminal. The same service may be had on the return trip. Thus the golfer, though traveling, may sit with his "tea" before him and so keep in touch with his game, thinking of his "tee."

The new car contains a lunch counter running its entire length, with comfortable revolving seats for twenty-seven persons. The interior of the car is finished in white enamel with light green ceiling and presents a bright, attractive appearance.



Plan of Luncheon Car on the C. & N.-W. Ry.

C. & N.-W. Lunch Car Ready for the Attack.

BOOK REVIEWS.

Boiler Design.

We have lately received a book just brought out. It is "The Design of Boilers and Pressure Vessels." It is written by Geo. B. Haven, S. B., and Geo. W. Swett, S. B. It contains 416 pages (6 x 9 ins.), 196 illustrations, and sells for $3.

The treatise represents the result of 15 years' experience in teaching the design of steam boilers at the Massachusetts Institute of Technology. Mr. Haven is Professor of Machine Design, and Mr. Swett is his assistant. In it the authors have sought to reduce the questions arising in the design of boilers and tanks to as direct a mathematical procedure as possible.

In Chapter I, the selection of materials and the conditions affecting the choice of a suitable factor of safety are discussed, as well as the effects of deterioration and its prevention by the use of linings.

Chapter II has as the basis for the design of pressure work in general, there is a thorough discussion of the theoretical stresses in cylinders, spheres and on flat plates. The stresses on dished heads, pins and hopper, and spiral seams are also taken up.

In Chapter III the subject of riveted joints is approached from the standpoint of maximum efficiency as well as protection against leakage. Approved methods for calculating the pitch, lap, efficiency and factor of safety are given, together with complete table of pitches, efficiencies and laps for ordinary thicknesses of plate and rivet diameters. The succeeding chapters deal with: IV, General Proportions; V, Design of a Horizontal Return Tubular Boiler; VI, Design of a Dry Back Scotch Boiler; VII, Design of a Vertical Straight Shell Multi-Tubular Boiler; VIII, Design of a Locomotive Type Boiler; IX, Tank Design.

Chapter VIII is useful to those who require a locomotive type boiler for stationary purposes. This type is often used in Round Houses for heating, and supplying steam for an engine to operate machinery. The remarks on the design of a horizontal return tubular boiler, Chapter V, are clear and to the point.

The book not only abounds in tables and formulas, and consequently requires some slight knowledge of arithmetic, but it contains practical hints, such as the correct forms of caulking tools, and explains how the work should be done, and the bad effects of careless or ignorant work.

The book is up-to-date, and covers the whole subject very fully, and as the science of figures underlies the conception of a properly designed boiler, the authors have gone most fully into that aspect of the case. A complete index, embracing tables, giving page where to be fonud: an index of plotted figures and a comprehensive index, close the book. It is an exhaustive work, and is a most useful and carefully written contribution to the literature of this most important subject.

The New Webster.

It may seem strange to say that a dictionary of the English language is very interesting reading, but it is nevertheless quite true. One does not, of course, read with any idea that there is a connected thought conveyed by the sequence of words, but each word in the whole book has its own distinct place as a vehicle of expression, and each has its exact shade of meaning, so that no two words are ever precisely alike, and many of them have obscure and curious origins.

The very word "curious," used above, comes from the Latin, meaning careful, and one of the definitions given in the new "Merriam-Webster" for this word is careful, scrupulous, nice, exact. Nice once meant "ignorant," and is derived from the Latin *ne-scire,* not to know. It may have been that ignorant persons were easily influenced by the opinions of others, and were pliant, not prone to objecting, and were thus agreeable and pleasant to those who sought to dominate them. Nice, in the sense of exact, refers to fine distinctions which give pleasure to some minds, and in this the idea of great carefulness prevails.

There is a tendency to spell the words "all right" as one word, just as "already" is spelt, and in time this usage may grow. Now, however, the New Webster does not give any authority for the usage. Some people speak of a "suppositious." The correct word is supposititous, but this implies some sort of substitution or fraud. Hypothetical is probably the word they are in search of.

Gantry comes from *gaun*, a frame for supporting barrels, and *tree* made of wood used with other words like gallows-*tree*. The gantry is originally the gaun tree or wooden frame for supporting barrels or other objects. Hence our use of the word. In other ways to be correct we speak of a herd of buffalo, a flock of geese, a covey of grouse and a bevy of larks. Custom or usage has stereotyped these phrases, and a good dictionary is the tabulated record of correct usage.

By the use of an authority such as this book one acquires a vocabulary, and when we speak in this way we do not mean that any man will become familiar with the 400,000 words defined in Webster's New International Dictionary, as the publishers, C. & G. Merriman Co., of Springfield, Mass., call it, but he will without knowing it take in the shades of meaning which the words he reads carry, and he will feel that having made them his own he has enriched his power of speaking and writing and that he rests on authority when he so uses the mother tongue.

The work is exceptionally good on derivation, and the definitions are clear and exact. The pages are divided into two parts, the upper and larger contains the words most "looked up," and the lower gives those less often sought, but all are there. The book contains a Gazeteer of the World. This is a geographical dictionary. There is a Biographical section, and a section on Foreign Phrases. A departure in a new direction is to be seen in the Reference History of the World. A section with special index, and giving 20,000 historical references which is most useful to all classes of users.

It is, as a standard work, primarily a dictionary of the English language, and it bases its authority on the best usage. The dictionary sets down for the use of the many, the careful work, and the educated and enlightened usage of the comparatively few of mankind who are entitled to speak on the subject and to be heard.

Graphite Brushes

Operators of electric power machinery are interested in the subject of commutation, and are fully aware of its importance in the electrical field. A large percentage of breakdowns in present day motors or generators must be charged against improper operation of the commutator and brushes. Graphite brushes are designed and marketed with the express purpose of reducing commutator troubles to a minimum. A booklet, "Dixon's Graphite Brushes," explains how the characteristic lubricating qualities of graphite are utilized to this end. The entire booklet is recommended for careful consideration, especially page 3, where the advantages of graphite over carbon as a brush material are clearly set forth. An electrical service department for the solution of brush problems is in existence in the Dixon office, and it invites detailed statements and will explain whether Dixon's brushes are adapted to the stated operating conditions. Frequently trial orders by enquirers have made enthusiastic supporters of graphite brushes. A copy of the booklet may be obtained free upon request made to the Joseph Dixon Crucible Co., Jersey City, N. J.

Results of Electrification

Circular 1505 is the latest publication brought out by the Westinghouse Electric & Manufacturing Company. Results obtained by electrification on some of the important steam railways of the world are included in this circular, giving information of interest and value to steam railroad operators on electrification work. Contained in this publication are well-illustrated descriptions of the Norfolk & Western, Pennsylvania, New York, New Haven & Hartford and other electrifications.

Personal Items for Railroad Men

P. Alquist, Supt. Car Dept. of M. K. & T. R. R., has moved his office from Sedalia, Mo., to Denison, Tex.

Tuckerton R. R., John C. Price, Gen. Mgr., Tuckerton, N. J., is in the market for one new steel coach.

Birmingham, Columbus & St. Andrews Ry., at Chipley, Fla., has one 10-wheel, 50-ton locomotive for sale.

The Sauvage-Ward Brake Company, Inc., New York, has recently changed its name to the Smith-Ward Brake Company, Inc.

Mt. Hood R. R., Supt. A. Wilson, Hood River, Ore., contemplates the purchase of flat and box cars and a steam passenger motor car.

M. J. McCourt, Gen. Car and Safety Appliance Inspector of the C. M. & St. P. Ry., has been transferred from La Crosse, Wis., to Milwaukee.

F. J. Kearney, Locomotive Foreman of the Gt. Northern Ry., has been transferred from Williston, N. D., to Willmar, Minn., replacing J. Cunningham.

Thos. W. Blinn has recently been appointed to the newly created position of Assistant Engineer of Maintenance of Way of the Northern Ohio Traction & Light Co., at Akron, Ohio.

Owen W. Middleton, formerly editor of the Railway Master Mechanic, has been appointed publicity manager of the American Steel Foundries with office in the McCormick Building, Chicago.

The Baldwin Locomotive Works announce the appointment of F. N. Hibbits as assistant general manager. Until July first Mr. Hibbits held the position of superintendent of motive power of the Lehigh Valley at South Bethlehem, Pa.

H. H. Eliot, whose recent appointment as Assistant Master Mechanic of the Maryland Division of the Philadelphia, Baltimore & Washington Railroad, with headquarters at Wilmington, Del., succeeds Mr. E. W. Smith, who has been transferred to the Altoona Machine Shops as Assistant Master Mechanic.

G. W. Sutton has recently been appointed storekeeper of the Richmond division of the Chesapeake and Ohio Railway at their 17th street shops at Richmond, Va. Mr. Sutton entered the service of the Chesapeake and Ohio in 1907 at the age of fourteen years and has been steadily rising in their service from that time.

A. J. Davidson, superintendent of the Portland division of the Spokane, Portland & Seattle Railway, has had his jurisdiction extended to include the Vancouver Division and Oregon Trunk Railway. This action was taken Aug. 1, 1915, when Mr. F. A. Brainerd was granted indefinite leave of absence on account of ill-health.

V. C. Randolph, who was recently appointed assistant superintendent of the Susquehanna and Tioga Divisions of the Erie Railroad, with headquarters at Susquehanna, Pa., was until July 1, 1915, master mechanic of the Rochester Division at Avon, N. Y. Mr. Randolph is succeeded at Avon by Mr. C. H. Norton, formerly general foreman at Huntington, Ind.

Fred Conder, recently made general foreman of the Chicago and Eastern Illinois Railroad at Terre Haute, Ind., entered the service of the E. & T. H. R. R. in 1907 and was made night roundhouse foreman in 1909. He succeeds Mr. F. C. Hasbrouk, who resigned to accept a position with the Interstate Commerce Commission as inspector in the Valuation Department.

The United States Light and Heat Company has been reorganized as the United States Light and Heat Corporation, of Niagara Falls, N. Y., with a capital of $7,000,000. The new company will take over and continue the operation of the former company's plant at Niagara Falls, and manufacture machinery, batteries and apparatus for the production of electric light and heat.

Thomas E. Corliss, Manager of the works of the Buffalo Brake Beam Company at Buffalo, N. Y., and Hamilton, Ont., died in Buffalo on July 9. Mr. Corliss' experience in the brake beam field covers more than thirty years, during which he was successively connected with the Central Brake Beam Co. and the Monarch Brake Beam Co. at Detroit, and for the last six years with the Buffalo Brake Beam Company.

Charles L. Raines, whose recent appointment as Master Mechanic of the Tennessee Railway Company at Oneida, Tenn., has been announced, succeeds Mr. J. F. Ashworth, who resigned to accept the position with the C. N. O. & T. P. as foreman, at Hickory, Tenn. Mr. Raines previous to his appointment as Master Mechanic was in the service of the Tennessee Railway as a steam shovel engineer for the past ten years, and previous to that he served as fireman on the L. & N. Railroad and on the C. N. O. & T. P.

Fred Carey was, on July 19th, 1915, appointed Master Mechanic of District No. 2 of the Intercolonial R. R. headquarters at Campbellton, N. B. Mr. Carey was born October 18, 1878, and entered the service of the Intercolonial as clerk in the office of the Traffic Auditor at Moncton on Sept. 1st, 1893. On March 4, 1901, he became locomotive fireman on the same road; Oct. 7, 1910, night round-house foreman; May 1, 1912, locomotive engineer, and May 19, 1915, acting Master Mechanic of District No. 3 with headquarters at Moncton. Shortly thereafter his present appointment was announced.

S. A. Wanger, who was recently appointed storekeeper of the Chesapeake & Ohio Railway at Clifton Forge, Va., holds a record of more than 28 years of continual service with that road. In 1887 Mr. Wanger entered the service of the Chesapeake & Ohio Railway in the maintenance of way department, and served as foreman and supervisor of track until August, 1908, when he was appointed assistant storekeeper at Hinton, which position he has held until the announcement of his present change. Mr. Wanger succeeds Mr. G. W. Sutton, who has been transferred as storekeeper to Richmond, Va.

John Edward Maun, who has been appointed superintendent of the Central Vermont Ry. with headquarters at St. Albans, Vermont, was born at Braintree, Vt., June 28, 1856. He entered the service of the Central Vermont Ry. as brakeman May 1, 1876, and after two years became freight conductor. In 1880 he was appointed yard master, and from 1881-1885 served as a passenger conductor on the National Ry. of Mexico, returning to the Ceneral Vermont as passenger conductor for thirty-nine years. January 1, 1915, he was made

Assistant Superintendent, which position he held until his recent appointment as Superintendent.

C. H. Norton, recently appointed Master Mechanic of the Rochester Division of the Erie Railroad with headquarters at Avon, N. Y., entered the service of the Erie as machine apprentice at Hornell in 1893 and completed his apprenticeship in 1897. He has remained consistently in the service from that time. From 1897 to 1905 he served as extra round-house and machine shop foreman at Hornell. He was then promoted to erecting foreman at Meadville. In 1906 he became assistant general foreman at Huntington and from 1907 until the date of his recent appointment as master mechanic he served as General Foreman respectively at Salamanca, Jersey City, Hornell and Huntington.

S. T. Cantrell, who has been appointed superintendent of the Philadelphia division of the Baltimore & Ohio, succeeding P. C. Allen, is a native of Tredonia, Kansas, and was born January 12, 1876. He was educated in the Kansas public schools and entered railroad service in April, 1895, as a telegraph operator and agent on the St. Louis & San Francisco Railroad. He was advanced successively to trainmaster, assistant superintendent and superintendent of that road. He became identified first with the Baltimore & Ohio in July, 1914, as supervisor of transportation, and in November was promoted to assistant superintendent of the Monongahela division, at Grafton, W. Va., from which position he was transferred to Keyser as assistant superintendent for the Cumberland division.

Charles L. Mason was recently given the position of superintendent of the Kansas City division of Atchison, Topeka & Sante Fe, with headquarters at Kansas City, Mo. Mr. Mason was born at Portland, Ind., on December 24, 1868, and entered railroad service in 1887. After filling various positions he became clerk in the Grand Central Station in Chicago. In 1888 he returned to the Atchison, Topeka and Sante Fe and in 1899 was appointed agent at Streator, Ill. In 1903 he was transferred to St. Joseph, Mo., as superintendent and agent, and July 1, 1914, became trainmaster of the eastern division, at Emporia, Kan. When Mr. D. S. Farley was transferred to Amarillo, Tex., Mr. Mason took his position as superintendent at Kansas City. Mr. Mason is succeeded at Emporia by H. R. Lake.

H. M. Manigault, who has been recently appointed General Foreman of the Erie Railroad at Marion, Ohio, succeeding William Moore, transferred, entered the employ of the Erie Railroad after leaving college in 1904 as special apprentice at Susquehanna, Pa., and Meadville, Pa. During 1907 he served as piece-work checker and machinist in the Hornell Shops and was in June, 1908, made erecting shop foreman of that shop. The next year he served as engine dispatcher at Ferrona and in 1910 he became technical and practical instructor of apprentices at the Dunmore Shops. In 1912 he was made assistant to the General Foreman of the Galion Shops and later roundhouse foreman at Marion, Ohio. Early in 1915 he was given the position of instructor of apprentices at the Meadville Shops, which he held until the recent announcement of his appointment as above.

Louis F. Beckert, a salesman with the Westinghouse Electric & Mfg. Co., died very suddenly at his home in Pittsburgh, Pa., on July 7. Death was due to typhoid fever.

Mr. Beckert was born in Pittsburgh in 1886. He received his early training in Bellevue Public Schools and later became a graduate from the Allegheny High School with honors. In the fall of 1903 Mr. Beckert entered Penn State College, graduating in 1907. While in college he made many friends, and was a member of the Sigma Nu Fraternity.

Upon the completion of his college course, he entered the employ of the W. E. & M. Co. as an engineering apprentice. After completing his course he accepted a position in the railway equipment division of the Railway and Lighting Department, in which department he remained until his death.

Phillip Cleveland Allen, who succeeds M. H. Cahill as superintendent of the New Castle division of the Baltimore & Ohio, was born at Rock Island, Ill., December 20, 1869. After attending the public schools, he entered railway service in 1889 as a clerk in the operating department of the Atchison, Topeka & Santa Fe Railroad, and after filling various positions with this company he became trainmaster in 1901. In 1902 he entered the service of the Chicago Great Western, where he remained until 1904, when he entered the employ of the Great Northern Railroad. Mr. Allen filled the position of assistant superintendent and superintendent of the Great Northern, continuing with this road until March 1, 1914, when he resigned and went with the Baltimore & Ohio. After several weeks' special work in the transportation department of the eastern carrier he was advanced to superintendent of the Philadelphia division, March 24, 1914.

Michael H. Cahill, former superintendent of the New Castle division of the Baltimore & Ohio Railroad, has been appointed superintendent of the Cumberland Division at Cumberland, Md., following the death of C. Lee French. Mr. Cahill was born at Lexington, O., November 19, 1872. He entered railroad service with the Baltimore & Ohio in November, 1887, as a telegraph operator at Lexington, O., on the New Castle division. In October, 1892, he was advanced to train dispatcher at Akron, and in February, 1905, became division operator at Akron. He was promoted to train master of the Pittsburgh division on May 1, 1910, and to assistant superintendent of the same division May 1, 1912. In August, 1912, Mr. Cahill was advanced to superintendent of the Newark division, resigning November 5 of that year to accept a position with the Delaware & Lakawanna Railroad, at Buffalo, N. Y. He re-entered Baltimore & Ohio service May 15, 1913, as assistant superintendent of the Cumberland division, at Keyser, and in the fall following was made superintendent of the New Castle division, being transferred to Baltimore January 1, 1915.

O. C. Hill, appointed general superintendent of the Kansas City Terminal Railway at Kansas City, in July, was born in 1873 and entered railway service with the Chicago, Burlington & Quincy as brakeman and later as conductor. In 1903 became conductor and brakeman for the Wabash at Moberly, Mo., and a year later was brakeman for the El Paso and Northeastern at El Paso, Tex. In 1904 he returned to the Chicago, Burlington & Quincy as switch foreman at North St. Louis, Mo., until 1906, when he joined the Missouri, Kansas & Texas as conductor and brakeman at Parsons, Kan. In 1907 Mr. Hill again returned to the Chicago, Burlington & Quincy, this time as night yardmaster at St. Louis, Mo., and was subsequently general yardmaster at St. Joseph, Mo., from September, 1910, to January, 1913; general yardmaster at Kansas City, Mo., from January, 1913, to September, 1913; general yardmaster at Galesburg, Ill., from September, 1913, to January, 1915, and assistant superintendent at Kansas City, Mo., from January, 1915, to July, 1915, when his appointment as general superintendent of the Kansas City Terminal Railway Company took effect.

Steel Sub-Under Frame for Wooden Freight Cars

By John H. Nagle, Chief Draftsman B. R. & P. Ry. Co.

Among the improvements which the B. R. & P. Ry. is making to its car equipment, is the rebuilding of 65 and 85,000 lbs. capacity wooden freight cars and supplying them with steel center constructions. This includes 65 and 85,000 lbs. capacity gondolas, 65 and 85,000 lbs. capacity hoppers and 85,000 lbs. capacity coke cars. Up to May 1st, 1915, over 3,000 center constructions had been applied in the different kinds of cars, and before the end of the year it is expected to have 6,000 in service.

Wooden B. R. & P. Freight Car Converted, with Steel Underframe.

The principal reason for applying these steel centers to the wooden equipment was to eliminate as far as possible repairs to sills and draft gears. The old cars have wooden draft sills secured to the center sills by means of bolts and draft keys and are not of sufficient strength to be placed in trains between steel cars. The steel centers now being applied are designed to meet the same conditions as a modern steel car, and when applied make the cars suitable for use anywhere in a train, with the same assurance of safety as can be expected from steel equipment.

Buffalo, Rochester & Pittsburgh Railway Wooden Gondola with Steel Frame Applied.

The 65,000 lbs. capacity gondola and hopper cars are of small capacity, compared with present equipment, but as these cars were all in very good shape, except for draft gear and sills, and as many customers along the road do not wish a larger capacity car, it was decided to equip the cars with steel centers and keep them in service.

The cars illustrated are an 85,000 lbs. capacity plain bottom gondola car of which there are over 1,000 in service, all equipped with the steel center construction, and an 85,000 lbs. capacity coke car, 240 of which are being equipped as rapidly as possible.

The center construction for the gondola car is of the fish belly type, 5/16-in. web plate, flanged at the top and reinforced at the bottom by two 3½-in. by 3½-in. by ⅜-in. angles, with top cover plate 7/16 in. by 21½ ins. The center construction has independent draft sills of ⅜-in. pressed "Z" bars, thoroughly secured to the web plates by ⅞-in. rivets, and the draft members extend 3 ins. beyond the face of the end sill. An independent cast steel striking plate is bolted to the wooden end sill and secured to the center construction. The coupler carry iron is supported by bolts at the end of the draft sills and by the striking plate. At the cross-bearers there are substituted cast steel side stakes for the old wooden stakes, through which pass a heavy tie rod flush with the floor, adding greatly to the strength of the sides and keeping them more secure. This stake runs beyond the side sill and is backed up by a malleable iron casting, securely riveted to the main cross-bearers.

The center construction of the coke car is also of the fish belly type, of the same weight of material with the exception of the draft sills, which are heavier and are flanged at the bottom and form a support for the end sill and also take the bolts which secure the end sill to the frame. An independent cast steel striking plate is bolted to the end sill and draft sill and supports the carry iron. At the end of the cross-bearers there is riveted a small "I" casting which supports the side sill and also the truss rod queen post.

These center constructions were designed in the railroad's own offices and fabricated by car building companies.

The old cars are brought to the shop, where the bodies are jacked up and placed on horses, the trucks run out and the body entirely stripped, with the exception of the side sills, stakes, side and end boards, which are left intact, and if these need renewal they are also replaced. When the trucks are out from under the car they are thoroughly gone over and repaired, after which the sub-underframe is set upon them, the side bearing clearance adjusted and they are again run under the car. The body is then lowered and bolted to place, and a new floor and new end sills applied. The old brake is applied and the car is fitted with complete United States Safety Appliances. The cars when turned out of the shop are therefore practically new.

WHAT IS ECONOMY?

The tendency on the part of some railroads to buy car hardware on a basis of first cost is no doubt imperative under present circumstances. Where there are not many dollars to spend, it is human to make an extra effort to "get the most for the money." True economy and the practise of getting the most for the money should be very closely related. The question is raised: does it approach to greater economy to buy brass hardware, or steel hardware for a passenger car?

For the former it may be said that brass or bronze hardware precludes by the nature of its material any possibility of rust. Its finish is quite permanent and scratches in the finish soon tarnish and assume an inconspicuous color. In fact some of the statuary bronze finishes applied, approach so closely the natural discoloration due to continued exposure to the atmosphere, that a scratch soon takes on the original shade of the finish. The special value of this feature becomes apparent when consideration is given to the service rendered by some of the hardware as, for instance, a baggage rack on which heavy, metal-bound cases are pulled back and forth, often leaving a trail of scratches.

For the steel it can be said, that the present trend in passenger car construction is toward steel for the interior trim as well as the frame and exterior finish of the car. For car hardware the steel can be given almost any finish that can be applied to brass or bronze, and steel hardware fulfills every requirement of strength.

In answering the question "What is Economy" we hold no brief for either side. Steel is strong enough and can be finished to look well enough until it is scratched or otherwise damaged. Brass and bronze also meet the requirements for strength and initial finish, will not rust, and maintain their initial finish in spite of scratches. These matters for and against must necessarily appeal to those who have the selection of this kind of material, and in this, as in other matters connected with railroad supplies, the decision cannot be reached in an arbitrary or off-hand manner.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE

The report of the Committee on Revision of Standards and Recommended Practice, of which Mr. W. E. Dunham (C. & N. W.) was chairman, was presented at the Master Mechanics' Convention. In it the committee said that they would recommend the revision and modification in the form of the present specification for steel axles for locomotive tenders to agree with the standard of the M. C. B. Association, Appendix A. The advancing of details of journal box, bearing and wedge from recommended practice to standards was also proposed. The committee recommended the revision and modification of the present specifications for boiler and firebox steel to that shown in Appendix B.

The revision and combining in one specification of those for locomotive forgings and driving and engine truck axles. Specifications for annealed and unannealed carbon-steel axles, shafts and other forging are in Appendix C. Specifications for locomotive cylinder castings, bushings, heads, steam chests, valve bushings and packing rings are shown in Appendix D.

Specifications (Appendix E) for locomotive cast-steel frames are shown as Recommended Practice. (See reports for appendices.)

Inspection and testing of locomotive boilers. To conform to the latest revision in the Federal Regulations for the Inspection and Testing of Locomotive Boilers and their appurtenances, your committee would recommend the revision of the following paragraphs as shown.

The lowest factor of safety to be used for locomotive boilers constructed after January 1, 1912, shall be 4. The lowest factor of safety to be used for locomotive boilers which were in service or under construction prior to January 1, 1912, shall be as follows: Effective January 1, 1915, the lowest factor shall be 3, except that upon application, this period may be extended not to exceed one year, if an investigation shows that conditions warrant it. January 1, 1916, 3.25; 1917, 3.5; 1919, 3.75 and 1921, 4.

For locomotives constructed after January 1, 1915, the maximum allowable stress per sq. in. of net cross sectional area on fire box and combustion chamber stays shall be 7,500 lbs. The maximum allowable stress per sq. in. of net cross sectional area on round, rectangular or gusset braces shall be 9,000 lbs.

Flexible stay bolts which do not have caps shall be tested once each month, the same as rigid bolts. Each time a hydrostatic test is applied, such stay bolt test shall be made while the boiler is under hydrostatic pressure not less than the allowed working pressure.

Reports of patches should be accompanied by a drawing or blue-print of the patch, showing its location in regard to the center line of boiler, giving all necessary dimensions and showing the nature and location of the defect. Patches previously applied should be reported the first time boiler is stripped to permit an examination.

When 31,189 tons of coal were loaded into vessels over the docks of the Baltimore & Ohio Railroad at Lorain, Ohio, on July 30, it is believed that a record of tonnage handled by one machine was established for the Great Lake ports.

Railway Master Mechanic

ESTABLISHED 1878

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CONTENTS

MECHANICAL OMNISCIENCE

It was stated by the Pennsylvania Railroad last month, that they had made about 2,000,000 efficiency tests of all kinds, and that the men on the road had responded. The record showed that 99.9 per cent. of them had lived up to the letter of the rules, and that only a fragmental fraction of the men had disobeyed. This figure approximates very closely to perfection pure and simple. Yet laying aside the effect on the report of the natural desire to make a very good showing, which invariably colors even the purest motives, the result is most eminently satisfactory.

There were 28½ per cent. fewer employes killed in the first 6 mos. of 1915 than in the corresponding period last year. This was not due to a heavy decrease in train mileage, as passenger train miles were only 6 per cent. and freight train miles, 8 per cent. less than in 1914. The figure for employes killed in 1914 was 119 and in 1915 it was 85. No passenger was killed in a train accident in the period covered by these tests. This record has been clear since 1912.

A decrease in accidents is invariably accompanied by a high record of efficiency on the part of all employes, as shown in the tests which are made regularly on the P. R. R. These tests cover the work of both officers and the rank and file. The records for the first 6 mos. of this year show that 23,390 tests were made in the use of signals, and 99.4 per cent. of them showed employes living up to the strict letter of the rules. Over 10,000 tests were made with signals set at stop, and in only 13 cases did the trains fail to stop before passing the signal by so much as a foot.

The value of efficiency, as shown in the decrease of casualties is beyond price, but the way it was here accomplished was plain to see. One of the principles involved in 99 per cent. of the men obeying the rules lies in the fact that they practically act alike. Human beings can lay no claim to being omniscient, they are not "mind readers," yet it is the ability to predict, with reasonable certainty the probable action of others, which is one of the strongest points in the whole matter. The signal system with its home and distant semaphores has a sort of mechanical omniscience, as far as two blocks ahead are concerned, and this gives the system its value. Looking at the signals, one knows, without seeing the entire track, just what one will encounter as the train goes on.

The human factor is known to be exceedingly erratic in physical failure, in that it does not, and cannot be made, to fail always in one direction, as the signal system does, so as to produce delay and not disaster. When this same human factor, in cases where rapid and clear judgment are required,—rising often almost to the level of emergencies—can by observance of rule or by tacit consent, always do practically the same thing, one can reasonably predict the action. The element of high probability for safety is introduced and it is of the same quality that is the property of the signal system though in the human case it lacks the signal's mechanical accuracy.

This observance of rule is not a mere matter of safety to the individuals on a train or in a "tight" position on the road, though it acts in their favor. It is also a means of approaching safety by others who under the rules expect their fellows to act thus and so. Others make their calculations, based on the probability that a careful and conscientious man will obey the rule, and feeling reasonably sure that this estimate of a neighbor's action is correct, they act expecting that he too has in mind the responsibility which his previous good record has produced.

No man lives unto himself alone and nowhere is this more true than on a busy railroad at the present day. The man who cuts corners, shaves off time allowance or "tempts Providence" in various ways, as we say, is a Chancetaker, and this kind of man has no legitimate place

on a railway to-day. He not only risks his own life and endangers those of his fellow-workers, but his action tends to break down the existing safeguard to others, built up by the predictable quality of good behavior.

In order to ascertain the reliability of conduct and to tabulate it for use in compiling figures for relative results a railway often resorts to what are known as "Surprise Tests." This is briefly the putting a signal in the "stop" position when there is no danger, and watching the result. Some think this kind of thing a form of "spying" on the men, and resent it accordingly. Others see in it the practice word of command that a soldier hears and respects.

It may be asked if the colonel of a regiment on parade may never call "halt," because no enemy is in the land? He orders the regiment to stop or advance, that in the army practice all may learn the meaning of the words, and all may work as one. An automatic cash register insures mechanical honesty when its drawer is closed, its bell rung, and it drops out the total of the various items to be paid for. No one feels aggrieved, for no one finds his good faith has been impuned, by the mechanical and faultless evidence of the sale.

We invite our readers of all ranks in railway service to consider the importance of the whole subject. Tests are not made merely to gain the applause of the public, by an adroit presentation of facts and figures which will make up in "display type" for the road's publicity department. It is above a mere self congratulatory flush of pride. It means the serious work of the road well done, by men who have to stop and think, and who intelligently go at a straight duty, however hard, with no thought of reward, but the sight of the warm and useful life of others around them, that they have helped to preserve, by action and example.

We invite our readers to give us the benefit of their views on the ethics of the Surprise Test. How do you view it? Is it right or is it wrong? Our columns are open to all those who, whether they agree with us, or whether we agree with them, will honestly state their convictions and beliefs. We want to arrive at a consensus of the best thought of the men who have to act bravely in arduous things. You think and act—we want to let the others know.

THE HUMAN ELEMENT

Among all the elements which Nature produces, the human element stands pre-eminently first, for without the human element the value of all the other elements in the world would be unknown The human element, so to speak, has discovered all the other known elements in the Universe and has put them ingeniously into practical use. We can, therefore, see how extremely important the human element is in this present day activity and progress, and how important it has always been. How much depends upon man is almost beyond comprehension, for he enters into every calculation that is made; in fact, man is the one who does the calculating and uses in his calculations all the other elements and most everything else besides. As a representative of his Creator, man is supreme. With this in mind we see with what importance the human element enters into all the affairs of a railroad and how much depends upon it to provide safety, efficiency and success generally.

If the human element fails, as it often, unfortunately, does on account of quality, it leads to trouble and expense, while the future success of an enterprise and its popularity may be doomed.

The human element is found in the president's chair and occupies the chairs and places of all the subordinates away down to the track-walker and the man who digs the ditches and labors in the most unimportant field. If the human element in the president's comfortable chair is lacking in quality, the entire organization is in danger of collapse; hence the importance of having a high-grade quality of human element for this enviable post.

Human element is responsible in the running of trains; handling switches and signals; furnishing facilities; securing business and paying interest and dividends, so that the human element at the top must have the genius of selection when he arranges for additional human element to carry out his policies and meet every requirement.

Every body of men, in time, takes its cue from the "boss." If he be a good one, the personnel and standard of his followers will also be good. This is an axiom—a self-evident truth.

How then can human element be improved? By what process, in its manipulation, can it be worked up to the point of high quality? What are the fundamental requirements in turning this raw material into a useful product?

In the manufacture of first-class chinaware it is extremely necessary that the clay and everything which goes into the preparation of the mass from which the chinaware is finally moulded be absolutely pure, otherwise the plates, the cups and saucers and every other table necessity in the way of china lack clarity and strength.

At the outset then, with this idea in mind, we must select the best available quality of human element to work up. Upon this in the moulding depends the quality of the finished product, which we, in the end, get in the way of presidents, general managers, trainmen, engineers, firemen, switchmen and every other class of talent required in the successful operation of such an important combination of human element as a railroad.

The human element becomes something that can be promoted from one position to the next one above, and so on, until the track-walker and the ditch-digger stand a chance to fill the highest positions on the road.

Stranger things than this occur every day. Some of our very best railroad managers started carrying water for the fellows engaged in track construction and worked along through the whole line of promotions to the top, because they were a first-class quality of human element to begin with.

When a young man applies for a position on a railroad with the notion that he is to make it his life calling, he

must be of good quality. He must have good health; a fair education, at least, and be willing to do what he is required to do, with the idea of obedience and civility in mind all the time. If, with these fundamentals he is honest and prompt, he then becomes a good quality of human element to put into the mixture for the purpose of eventually securing clarity and strength in the whole organization. Environment and attention, with every encouragement, then do the rest. Each department is then backed up, as it were, by beginners, who in time become the mainstay of the business.

The beginner later on trains his immediate subordinates and in due course we will have a great combination of talent all worked up from the first-class quality of human element which was selected in the first instance.

We have found on many a railroad which was down in the ditch, burdened with debt and misfortune and struggling along under a receiver's supervision, no end of first-class human element, but because the enterprise lacked a captain made of good human element, too, they had been misplaced and not turned to the most useful account of which they were capable. Bad management, bad handling, bad guidance did it and ruined the road; in other words, a poor quality of human element had been introduced into the mixture. This sort of a wreck is the kind that some good specimen of human element takes hold of finally, puts it on its feet and thereby "makes a record." A grand chance for one, too.

So when we talk about the human element being the cause of a bad accident or a hopeless financial failure, it means that somebody exercised bad judgment, somewhere; "somebody blundered," as was the case at Balaklava. The fault primarily lay in the quality of human element which entered into the make-up and the management of the organization.

It is a great subject, this one of the human element. Now that we are on the verge of great possibilities in the railroad world, the human element will have a greater part than ever to play, with the object in view if possible of preventing another disastrous season in affairs such as we have just passed through. This, to a very large extent, in fact almost entirely, depends upon the human element, and the railroads are miners of human element on the largest scale, and consumers of it, as well, in the largest degree, in the world.

IMPORTANCE OF SERVICE TEST

Laboratory tests are not only most useful and highly instructive and are, one may say, the more strictly scientific counterpart of the service test. The laboratory test often directs the seekers for truth to look in a clearly indicated direction for some incipient defect or suggests other lines of investigation than the one originally chosen. The very fact that the laboratory test is more or less scientific in its scope, necessarily restricts its immediate enjoyment to the particular group of workers who have it in hand.

The service test, however, forces its lessons upon the railway rank and file. They may read and study the many and ample accounts of the scientific work of the test room, so generously given to all classes of railway employees, but the service test is before their eyes, where no artificial conditions can be applied and no restrictions can be imposed, which are sometimes necessary in the laboratory, to develop study on some particular line of investigation.

In the M. C. B. report on "Couplers" the committee urge upon the members of the association the necessity for the data derived from road service tests. They point out that many of the existing couplers operated perfectly when first designed or placed in service. These couplers will continue to give satisfaction until wear or distortion of parts affects them. It has required from two to three years of service to develop these conditions.

The committee stated that they could not too strongly impress upon the members of the M. C. B. Association the absolute necessity of not only placing a sufficient number of the experimental standard couplers in service, from the performance of which to draw proper conclusions, but it is also necessary to follow up particularly the behavior of the couplers and to note what takes place under conditions of wear and distortion.

The more carefully this work is done, the more complete will be the data obtained and the more perfect will be the coupler finally adopted and made standard. It is with this end in view that the committee appealed for assistance from members. The conditions of every day service vary so completely and so constantly that the service test provides, almost automatically, a wide range of actual occurrences, the summation of which results in the longer or shorter life of the coupler, or it provides occasions for the more or less efficient performance of the work it was intended to do.

If a certain number of various makes of couplers are tested to destruction by the laboratory method, a summary and scientific weeding out of the unfit takes place, and this investigation clears the ground and simplifies the study of the whole question. It is therefore most useful and necessary. The service test, with its wear of parts and its distortions due to strains of all kinds, is bound to take time, and the progress toward ultimate failure or renewal must be closely watched and intelligently studied all through its course. The laboratory and the service test go side by side as our guides to knowledge, but it is equivalent to working with only one hand to rely upon the one set of tests without having the assistance of the other.

Referring to Mr. Taft's speech at the Bankers' convention, *The Bach Review* reports that the ex-President says that "we must grant increased rates to the railroads, and do it quickly. That their prosperity is important to the prosperity of the country, because their expenditures create a very large part of the demand for our manufactured goods. That millions own their stock, and they employ millions of men. He calls it outrageous injustice to make the railroads carry the enormous burden of the parcel post for nothing. He says the Full-Crew bills should be repealed, because they impose upon the railroad companies the burden of employing unnecessary labor."

Shay Locomotive for Kansas City Southern Railway

Out in far-distant Kansas City the switching problem is one of more than passing interest, and to satisfactorily solve the problem of pulling and pushing cars around sharp curves and up heavy grades in the city, and doing it all without causing smoke and cinders, the Kansas City Southern Railway has employed what are called Shay Articulated Geared Locomotives.

The articulation consists in the fact that the engine truck can turn slightly about its center when rounding curves, and so can the tender, which is supported principally on a center bearing truck. Every wheel under engine and tender is a driving wheel, and each wheel is provided with a bevel gear face, in which bevel pinions mesh.

The boiler is set a little off the center line of the track in order to provide for three vertical engines which drive on a common shaft, parallel to the track. The wheels are mounted on rigid axles in the usual way, so that when the right hand wheels are driven by the horizontal shaft the left-hand wheels are also rotated. The locality where these engines, for there are two of them, have to operate is a difficult place to work in, but the Shay locomotive is well adapted for the conditions as they exist.

wheels in all, and all are drivers. The tractive force of the engine is 62,500 lbs., while the weight on the wheels of engine and tender are together 260,000 lbs. and 80,000 lbs., of which 80,000 lbs. is on the tender. If this weight was concentrated upon the drivers of an ordinary engine the axle load would be exceedingly heavy and the tractive effort might go about 65,000 lbs. This would probably require large cylinders and small drivers and a high boiler pressure. The Shay engine does as well as or better, with all its parts normally proportioned, small cylinders and ordinary axles.

The gearing of the wheels greatly increases the tractive effort without enlarging the parts. The factor of adhesion is 4.1 and this figure is secured with the entire elimination of slip, due to the gearing. The factor of adhesion is the weight on the drivers divided by the tractive force.

In order to deal with the smoke nuisance and to prevent the throwing of sparks and glowing cinders within the city limits, the engines are designed to burn oil, and the machines themselves are fitted with all the modern appliances for economical working. The engine runs backward or forward with equal facility and carries a

G. F. Hess, Supt. of Mach. - Shay Geared Locomotive for the Kansas City Southern Railway. Builders, Lima Loco. Corp.

The new terminal tracks in Kansas City go along May street to a point south of Seventh street, and go on under the Eighth street Metropolitan tracks where the Kansas City Southern will do switching underground. On account of the heavy grade on May street, which is 7 per cent, the work could not be very well handled by any other type of locomotive. The new Shay locomotives are handling 200 tons up the May street grade, and go around uncompensated curves of 60 degs.

The Shay Articulated Geared Locomotive is designed for service of this kind, and one of the most important features in connection with the operation of this type of locomotive is the fact that it is under complete control in ascending or descending steep grades, also in turning the many and sharp curves. Being geared, there is practically no slip, and in going down hill there is little or no tendency to "run away."

Our illustration shows one of the engines. It is a 130-ton machine, the other being 160 tons. There are 12 head-lamp on the back of the tender. The engine was built by the Lima Locomotive Corporation of Lima, Ohio, who also have an office at 50 Church street, New York.

Some of the principal dimensions of these interesting locomotives are appended for reference:

Gauge	4 ft. 8½ ins.
Service	Switching
Fuel	Oil
Tractive effort	62,500 lbs.
Weight in average working order	260,000 lbs.
Weight on drivers	26,000 lbs.
Wheel, rigid	72 ins.
Wheel base, total	46 ft. 10 ins.
Wheel base engine	34 ft. 0 ins.
Cylinders, number	3
Cylinders, diam. and stroke	17 x 18 ins.
Valves, kind	Slide
Type	Allen-Richardson
Greatest travel	4⅝ ins.
Outside lap	29-32 in.
Inside lap	0
Lead	1-32 in.

Wheels, diameter over tires	46 ins.
Thickness of tires	3 ins.
Driving journals, diameter and length	7 x 8 ins.
Boiler, style	Extended wagon top
Working pressure	200 lbs.
Outside diameter of first ring	62¼ ins.
Firebox length and width	114 x 61¼ ins.
Firebox water space	4 x 4½ ins.
Tubes, number and outside diameter	308—2 ins. diam.
Tubes, length	13 ft. 5 ins.
Heating surface, tubes	2,150 sq. ft.
Heating surface firebox	178½ sq. ft.
Heating surface, total	2,328½ sq. ft.
Grate area	48.4 sq. ft.
Center of boiler above rail	99⅜ ins.
Diameter of boiler	62⅝ ins.
Weight of tender	80,000 lbs.
Water capacity	4,000 gals.
Fuel oil capacity	1,950 U. S. gals.

LOCOMOTIVE CHARACTERISTICS

The calculated tractive force of a locomotive is a figure constantly used when comparing different machines. It holds good practically at slow speeds, and is not necessarily an accurate measure of what the engine will do at high speeds.

The formula usually given to work out the tractive effort is:

$$T = \frac{d^2 \times s \times P}{D}$$

where T is the tractive effort, d is the diameter of the cylinders in inches, P is the steam pressure in lbs. (taken at 85 per cent. of the boiler pressure, according to the Mast. Mech. Association rule), and D is the diameter of the drivers in inches.

This formula is derived from another, which, when written out in full, shows its "construction" and is easy to explain. The full tractive effort formula is:

$$T = \frac{d^2 \times .7854 \times 4\,s \times .85\,P}{3.1416\,D}$$

It is here evident that the expression, $d^2 \times .7854$ is simply the area of the piston, against which the steam pressure is applied. The expression $4 \times s$ is four times the stroke in inches, and as there are two cylinders and as the piston in each makes two strokes to one revolution of the driving wheel, the stroke is taken account of four times. These two expressions, $d^2 \times .7854 \times 4 \times s$, give the area of the piston pushed through a distance equal to four strokes. If followed by steam, the mental conception of the whole thing looks like a horizontal pillar of steam of the given diameter and of the specified length, i. e., four strokes.

The boiler pressure is then ascertained, and is reduced to 85 per cent. of that shown on the gauge. This is taken as about equal to the initial and the expanded steam in each of the four strokes, and it thus practically becomes an average. Some people think the average is too low for every-day practice, but it has been determined by the Mast. Mech. Assn. from tests, and is believed to represent a fair average. In any case, if this 85 per cent. is used in all calculations of this kind, it helps to make the comparison of engines all alike, and when this average is universally used it does not introduce any error due to change of average in one case and not in another.

We have mentally before us practically a solid pillar of steam four strokes long, cylinder diameter, and up to 85 per cent. of the boiler pressure. When we have drawn this horizontal pillar of steam out of the boiler we have turned the driving wheels round once. We now divide the figure representing the pillar of steam, which is in inches and pounds (the units of length and pressure) by the circumference of the driving wheels in inches; we get the pull on the rails in pounds, or the power that would slide smooth rails backward under the drivers, if the rails were free.

As the rails are not free, the engine is compelled to move forward, and the pull that is experienced may be had by hooking anything on behind, whether it is attached, like the tender, to the shackle-bar, or if it is tied on anywhere, by a tail rope or otherwise, to any part of the moving machine.

If this last and longer formula be worked out, it gives the tractive effort at slow speeds; otherwise the average of 85 per cent. of the boiler pressure would not be close enough to the truth. This effort is also called draw-bar pull, though that expression usually implies that you should deduct 10 or 12 per cent. for the internal friction of the engine.

The last and longer formula may readily be turned into the shorter and simpler formula, given first, by the process of cancelling, and it will be found that when the *figures* are cancelled the long formula becomes the short one, as the figures cancel each other, though both formulas work out to exactly the same result.

In this connection, it is interesting to recall a remark made by Mr. George R. Henderson at a recent meeting of the New York Railroad Club. He called attention to two conspicuous facts about locomotive capacity, the first being the advantage possessed by engines with trailing or carrying wheels, due to their higher relative steaming capacity (they have large fire boxes). The second is the rapidity with which the tractive force of eight-coupled engines decrease as compared with six-coupled wheel locomotives. At 7 m.p.h. Consolidation and Mikado types can each haul 3,000 tons, while 10-wheel and Pacific types cannot exceed 2,200 tons. With a 1,500-ton train, the Consolidation shows practically no superiority in speed when compared with a 10-wheel engine. At 40 m.p.h. the hauling capacity of the Mikado and Pacific types are nearly alike. The same thing is true, and even to a greater extent, of the Consolidation and the 10-wheel type of locomotive.

ORIGIN OF "SAFETY FIRST"

A great deal has been said of the origin of the Safety-First movement. It will interest railroad men to know that the earliest record of systematic eye protection is that of the Crane Company, which in 1897 began to provide eye protectors for their men, and in 1898 put this work on a systematic basis, giving the glasses to the men free of charge and requiring operators, as far as possible at that time, to wear the glasses constantly when exposed to flying bits of metal, emery, dust, glare and hot metal. Dr. A. M. Harvey, who at that time was and still is their chief surgeon, was the originator of this plan of providing glasses for the men, and the fact is that since the company has been providing glasses eye injuries have been reduced to an extremely low point. This proves the value of having workmen protect their eyes in the shops. The company posted signs, placed conspicuously at various points in the shop, drawing the attention of the men to the necessity of using glasses and the fact that the glasses were provided free of charge. The safety movement is thus believed to have been largely due to the originality and activity of Dr. Harvey. From this time on the safety first idea has taken hold strongly on the railway world.

New Offices in the Grand Central Terminal Area

ABOUT the time that this issue of the RAILWAY MASTER MECHANIC reaches its readers the Railway Periodicals Company will be settling in their new quarters in the Vanderbilt Concourse Building. It seems unusually fitting that this paper should be published from an office overlooking, as it does, one of the greatest accomplishments of railroad terminal progress. The Vanderbilt Concourse Building, at the corner of Forty-fifth Street and Vanderbilt Avenue, on the nineteenth floor of which the new offices are located, lies within the area of the terminal, over a portion of the incoming express service tracks.

The great progress in railroading which permits the development of a project of the intricacy of the Grand Central Terminal is being carried here to its most complete fulfillment. By operating all trains entering and leaving the terminal with electricity and below grade, the elimination of smoke, steam and most of the noise and vibration makes possible the use of the same area for offices, hotels, theaters and other buildings which will be made to play their part in making the terminal project self-supporting. From an economic standpoint this use of terminal property for commercial buildings has gone far toward solving the problems of railroads confronted by the necessity of investing in expensive and otherwise non-productive terminal facilities.

One of the largest items that railroads have had to charge to their advertising has been the difference between the cost and upkeep of a modern terminal and that of some much less expensive and extensive building which might accommodate the same number of trains and passengers.

From a standpoint of evolution, the first concessions, such as lunch rooms, news and cigar stands, which were early encouraged in small railroad stations, were followed in the natural growth of the station by the cab stand, the barber shop, the drug store, until now the modern terminal often includes shops to supply every need of the traveler, restaurants which successfully compete for the patronage of the most fastidious, taxicab and transfer stations, to say nothing of offices for the use of all departments of the railroad and even space enough to be rented to the public. The last development has been the handling of traffic in such a way that much of the property is not prevented by its use as a terminal from earning its natural income by the construction of such buildings as might be erected in the heart of a large city.

The Grand Central Terminal comprises an area of seventy-nine acres between Madison and Lexington Avenues, extending north from Forty-second Street to Fifty-sixth Street. Its sixty-seven tracks on two levels, comprising thirty-three and a half miles, give a capacity of 1,053 cars and are handling from seventy-five to one hundred and twenty-five thousand passengers a day with

Grand Central Terminal area. Just level with and to the left of the tips of the spires of St. Patrick's Cathedral near the center of the illustration are the windows of the new offices of the Railway Master Mechanic.

a possibility of increase to care for the future. The dominant idea has been to combine beauty and magnitude with convenience and serviceability so that the thousands of travelers from all parts of the country who enter the city each day may go about the terminal with as little confusion as possible in passing from one room to another. The station was built under traffic and the entire plant changed so that not a vestige of the old remained while eight hundred trains a day were being operated. As each new track or group of tracks was finished a corresponding number of old ones was abandoned and traffic went on without interruption.

Looking north on Park Avenue from Our New Offices in the Vanderbilt Concourse Building, showing the area under which the inbound and outbound tracks are laid.

The Grand Central Terminal is probably the largest, and promises to be the most successful, combination of the esthetic and practical in city building yet developed in America. Where other idealistic group plans have failed or remained incomplete because dependent upon appropriations by the city, this will succeed because of its earning power. By depressing the tracks below the street level, Park Avenue and the cross streets from Forty-fifth Street to Fifty-sixth Street have been built in, thus reclaiming about twenty city blocks and throwing the entire area open for building purposes. This property over the railroad yards, when leased, will turn in a revenue that will help to pay interest on and to retire the large amount of capital involved in the terminal and the correlated improvements.

In the main terminal building are the waiting rooms, concourses, baggage rooms, retiring rooms, information bureaus and all the other features of a highly developed modern railroad station. The outbound concourse is the principal feature. The facilities afforded the outbound passenger are so arranged that the movement of the traveler is progressive, the ticket window coming first, the Pullman window next, then the baggage checking office and so on,—no steps have to be retraced. From the concourse, passengers proceed to the train room, which is reached by broad ramps of easy grade.

The waiting rooms are unique in station construction in that they are located where it is unnecessary to pass through them in going from or to trains. Adjoining the waiting rooms are the men's and women's retiring rooms, barber shop, lavatories and dressing rooms which provide convenient facilities for changing apparel and removing the stains of travel. Adjoining the concourse and the suburban level is the restaurant which takes its place as the peer of any restaurant in the best appointed hotels.

Among the unusual features in the construction of the Grand Central Terminal one of the most interesting is the elimination of stairways by the use of ramps or inclined walks, which provide for the movement of the greatest number of people with the least confusion. The

The outbound concourse of the Grand Central Terminal

grade of these ramps was determined after a number of interesting experiments with temporary ramps and as a result very easy grades were established. Another feature is the complete segregation of the through and local inbound and outbound traffic. This is accomplished by having separate waiting rooms and concourses for the local and through business and a separate station for the incoming traffic. Counter currents of travel and the resultant confusion are thereby eliminated. The tracks are arranged on two levels, the upper for through or express service and the lower for local or suburban service. Both are connected with loops which circle around the main building. Local incoming trains can thus be placed ready to receive outbound passengers on the proper tracks without switching or reversing the position of the engine, as would be necessary in a "stub end" terminal.

The station for incoming travel is located just across Vanderbilt Avenue to the west of the main building. It

Vanderbilt Avenue north from Forty-second Street. The last tall building on the left is the Vanderbilt Concourse Building.

has subsurface connections with the main building and direct exits to the subway and street. The incoming platforms are so arranged that all passengers leaving the trains must pass in review before the people waiting for them.

All of the light, heat and power necessary for the operation of the terminal and in fact for all of the buildings to be erected within the terminal area are supplied from a central station where the facilities and experience of the railroads entering combine to ensure economy.

Having thus daily under their constant observation this most wonderful railway terminal accomplishment in America cannot fail to give to the editors and management of the Railway Master Mechanic, in their new quarters, an inspiration which will materially assist them in their continuing efforts to make this paper of increasing value and benefit to the railroads and the railroad men whose interests they serve.

AN EVENT UNPARALLELED

Many strange events occur from time to time on a railroad, growing out of the failure of either man or material, or both. A history of these happenings put in print would fill many volumes.

About twenty-five years ago, when the Long Island & Eastern States line was in operation, trains were run between Brooklyn, Long Island City and Boston and intermediate points via the Long Island Railroad; a boat transfer across the Sound from Oyster Bay to Wilson's Point, Conn.; the Housatonic to Hawleyville, and thence over the old New England road to Boston. Traveling men and theatrical troupes dubbed it "The Great Zigzag Route." It was well named, but only a few ventured on a journey that way after the first trip. The route and service furnished almost everything in the way of transportation problems known up to that time. A vestibuled express, on the regular schedule, occupied attention both ways nightly, and on occasions was known to reach its destination on time. It was very late in the fall when one of those odd happenings referred to involved this night express. Early in the morning, somewhere this side of Boston, going at reduced speed in a fog, it ran into the unprotected rear end of a heavy freight on the New England, whose engine had broken down and, thus stalled, was carelessly waiting help. In a few minutes, as if attacked by a submarine without warning, and before the brakeman sent back could reach a reasonable distance to prevent it, the night express was run into by a fast steamboat train from Norwich, killing every one in the sleeper of the night express and setting fire to the train, resulting eventually in its complete destruction. There was nothing left of it except a tangled mass of iron rods and wheels.

In the excitement following and for lack of proper protection, a heavy fast freight train, at top speed, then ran into the rear end of the Norwich boat train, and the four trains in collision, occupying a mile or more of track, were piled up in a shapeless mass. One passenger in the sleeper of the night express was so absolutely and completely wiped out of existence that the New England Railroad Company refused to pay damages to his widow, claiming, with some reason, that he was not on the train. Not so much as a tooth or a key could be found to prove his identity. A friend, however, who had seen him board the train that night at Long Island City, with a ticket to Boston, was the means finally of securing for his widow the sum of $5,000.

In the annals of railroading it is safe to say that nothing so strange and gruesome as this ever happened. Service was discontinued altogether soon afterward, the route was broken up into its several separate parts, and the Long Island & Eastern States line became an item of railroad history only.

Iron and Steel Products, No. 17952.—A business man in Portugal has supplied an American consular officer with specifications for mild steel plates, angles, bars, etc. The man desires to receive cable quotations on these commodities. The specifications, etc., may be had on application to the bureau or its branch offices.—*Commerce Report.*

It is necessary to our rank as spiritual creatures that we should be able to invent and to behold what is not; and to our rank as moral creatures that we should know and confess at the same time that it is not.—*The Seven Lamps of Architecture.*

Fuel Oil for Coast Engines of the Grand Trunk Pacific

The Grand Trunk Pacific Railway intends to operate its line from Prince Rupert, B. C., east as far as Jasper, Alta., a distance of about 720 miles, with fuel oil, as soon as the necessary storage facilities are completed. This is being done in order to minimize the danger of fires in the Western forests, which so greatly beautify the territory called the "Paradise of Tourists." It is also being done to increase the efficiency of the traffic service and as a matter of fuel economy.

Mr. Eugene McAuliffe, general fuel agent of the Frisco Lines, has gone into the matter very thoroughly. He said, among other things, that the total petroleum production of the world in 1902 was 185,167,961 barrels, increasing up to 1910 to 335,388,368 barrels of 42 gallons each. Of this amount Canada produced in 1902 530,624 barrels, with 1,000,000 in 1910. Reduced to coal on a basis of four barrels of oil to one ton of coal, the 1910 production of petroleum would represent 83,847,092 tons, or, again reduced to coal in car lots, a string of gondolas and hoppers that would make a train approximately 16,000 miles in length. This great volume of liquid hydro-carbons is well scattered over the world, and furthermore only a portion of the oil produced is consumed as fuel, the major portion going for illumination, lubrication and certain special purposes, including the propulsion of automobiles, motor boats, auto trucks, etc., where coal would not otherwise be used.

Crude petroleum is a natural bitumen composed mainly of the combustible elements, carbon and hydrogen. In appearance it is a brownish black viscous fluid and is about 14 per cent. lighter than water. The word "petroleum" is derived from the Latin words "petra," a rock, and "oleum," oil. By subjecting petroleum to heat the lighter and more volatile portions are separated. The denser portion of the residuum is adapted for furnace fuel. The continued application of heat eventually produces residuum, known as petroleum coke, which is an extremely hot fuel.

Geologists give petroleum a place ranging from the beginning of the lower Silurian formation, void of animal and plant life, up to the Carboniferous period. When oil is found above the coal measures, it is because it has followed the stratification upward, rock pressure forcing it from behind. Scientists differ as to the origin and formation of petroleum. The organic theory is that the oil is formed by the decomposition of plant and animal life, and this produced oils containing a paraffine base. The theory holds that asphaltic oils, commonly used for fuel purposes, were distilled in Nature's laboratory from billions of decayed fish and shell life.

The inorganic theory of the mineral origin of oil is based on the supposition that water percolating down through fissures in the earth's crust and coming in contact, under conditions of high temperature and pressure, with metallic carbides produced a chemical reaction with the result that metallic oxides and saturated hydro-carbons were formed, which in turn re-ascended and were collected, and they were here trapped, enclosed by impervious rock or marly clay, and the pools remained hidden until exposed by man. Perhaps one of the best arguments in support of the inorganic or metallic hydro-carbon theory is in Bulletin 401 of the United States Geologic Survey.

Generally speaking, oil is said to be found in oil sand; this is, however, a misstatement, the porus sandstone or limestone (dolomite) holding the oil much as a sponge holds water. Spindle Top field, near Beaumont, Tex., is the field that startled the world with the Lucas gusher

Grand Trunk Pacific Oil Tank Steamer at the Wharf; Oil Pipe Lines at Prince Rupert, B. C.

which began with a production of 75,000 barrels daily. Later on the Heywood No. 2 well came in with an initial daily production of 96,000 barrels, this well producing a total of 1,395,000 barrels during its life of ten months. The volume of petroleum which the United States contains is a hard matter to estimate, but the Petroleum Division of the United States Geological Survey think it is about 15,000,000,000 barrels. If the present rate of production remained stationary the supply would last perhaps 85 or 90 years.

Grand Trunk Pacific Railway, Showing Shops and Oil Handling Plant.

To Russia, the second oil producing country in the world, is due the credit of first using petroleum for fuel purposes. Earlier experiments were made in oil burning. Almost simultaneously an Englishman, Aydon by name, an engineer by profession, and Spakovsky, a Russian photographer, invented what they called a "pulverizer," an apparatus which was the forerunner of our present burner and which atomized the oil, reducing it to a vapor which was blown into the furnace in gaseous form. It is possible to construct a burner of gas pipe swedged to a size and shape, as demonstrated by practical tests, that will burn oil. Of more importance than the type of burner is that of placing it and keeping it in proper alignment, regulating the volume of air necessary for perfect combustion. It is most important that the complete admixture of the oxygen and petroleum vapor will not only properly combine but will fill the fire box with burning gas. Thomas Urquhart, locomotive superintendent of the Grazi & Tsaritzin Railway, of Russia, applied "pulverizers" or burners to his English-made locomotives, thus marking the beginning of the use of petroleum as a locomotive fuel

Oil Pipes on Foot Bridge, G. T. P.

Out of 77,697,568 barrels of petroleum produced in California in 1910, a total of 50,720,000 barrels were used for fuel purposes, oil practically displacing coal as a railroad, steamship and manufacturing fuel on the Pacific coast. The principal advantages claimed for burning oil as compared with coal can be summed up as follows: 1. The item of cost depends on relative price at mine plus freight to point of consumption. The fact that from 1,000 to 1,500 lbs. of oil equal 2,000 lbs. of coal must be taken into account. 2. Decreased cost of handling oil from cars to engines with practically no loss by depreciation, as is the case with coal, in the handling. 3. Losses by evaporation suffered by coal do not apply to oil, neither do losses by theft in transit occur, oil reaching engine tenders unimpaired as to quality and undiminished in quantity. 4. Saving of time at terminals and increased mileage of engines, it being unnecessary to clean fires. More fuel can be carried, making longer runs possible. 5. Freedom from physical failure of firemen in extremely hot weather, the fireman's work is actually lighter than that of the engineman. 6. Stability of delivery, oil being largely unaffected by labor conditions. 7. Greater cleanliness in handling of passenger trains; almost complete immunity from right-of-way fires. The drawbacks to the use of oil have been in the direction of uncertainty in the supply.

Fuel oil for the Grank Trunk Pacific Railway will be supplied by the Imperial Oil Company, who are building a storage plant at Prince Rupert, B. C., not only for the fuel oil, but for other products. The oil will be brought in oil steamers from Southern California to Prince Rupert, and the boats will be moored at a special dock in front of the mechanical department yard. The oil storage plant at Prince Rupert is placed on high ground immediately behind the roundhouse. An overhead bridge, which is to be also used as a foot bridge, is to carry the pipes over the tracks to the storage house to which the oil will be forced by the ship's pumps from the wharf at the end of this bridge. The oil will feed by gravity from the storage to the service tank for all engines stationed at Prince Rupert and also to the loading rack at which the cars will be loaded for carrying the oil to other terminals. These terminals are Pacific, Smithers, Endako, Prince George, McBride and Jasper. The fuel oil station at each of these terminals will consist of three car unloaders dumping into a 240-barrel steel sump, set in an underground concrete pit. This pit forms the foundation for the building in which the service tank and pumps are placed. The buildings are frame with galvanized iron sheeting and completely surround the 600-barrel service tank which is set up on an elevation of 16 ft. 6¼ ins. above the base of the rail.

The main storage tank, built to hold 10,000 barrels, is as near as possible to the service tank, and the pumps are arranged to lift oil from the sump to the storage or

service tanks and also from the storage to the service tank, and from there it is delivered through a self-registering measure to the tenders of the locomotives. The storage tank is 52 ft. diameter and made of 5/16 in. and ¼ in. steel plate, and the bottom has been specially designed to avoid the necessity of rivetting up and then lowering on to the prepared foundation.

This is done by making the bottom in segments, along the radii of which angle irons are shop-rivetted. The sections are laid in place and the other legs of the angles are field-rivetted from the upper side so that the plates can be laid down in position and do not require to be moved again. The storage tank is protected from the weather by a frame covered with corrugated iron roofing, and the tank is fitted with steam coils around the suction pipe to warm the oil before it is drawn to the pumps. Similarly the service tank, which is ¼ in. plate, 17 ft. diameter, with spherical bottom, and supported on four I-beam columns, is heated with steam coils to maintain the oil at a temperature of 100 degs. F.

In such a cold country as North British Columbia, the chief idea has been to adequately protect the whole plant in severe weather and to save the loss of heat by radiation which would occur in attempting to maintain the oil in a fluid condition, in unprotected steel tanks.

In regard to the locomotives which have been converted, these are engines built originally as coal burners by the Montreal Locomotive Works, Canadian Locomotive Company and Canada Foundry Company. The types which have been converted so far are standard 8-wheel passenger engines, 10-wheel engines, Pacific & Consolidation types, the first two having narrow fireboxes and the two latter types, wide fireboxes. The enquipment comprises as characteristics, engine, general right side of the engine, to the heating pipes which enter the tank through the top plate, and go down to within 6 ins. of the bottom of the tank, ending in Tees to distribute the steam.

The only connections to the bottom of the tank are for the oil and drain valves. The oil valve seat is raised 2⅝ ins. above the bottom of the tank, and the drain valve seat is flush with the bottom, so that the water of condensation and water from the oil, has space to collect and be drained off, thus only oil is allowed to enter the feed pipe to the burner. A

G. T. P. Oil Storage Tank.

safety valve controls the flow of oil from the tank, which can also be cut off by a globe valve in the oil line on the tender. The safety valve is held off its seat by a pin through the valve rod, where it extends out of the gland on the top of the tank. This pin is connected by light chains to the cab roof along each side of the boiler, so that it can readily be released by the enginemen, in which case the valve is forced to its seat by a spring.

The oil pipe leads along the left side of the brick pan to the superheater. Steam for the superheater is controlled by the middle valve of the three on the firebox end, the third valve being for steam to supply the atom-

Grand Trunk Pacific Railway Locomotive Fitted for Burning Oil Fuel.

arrangement; tender; tender oil tank; and front end arrangements. The tender tank has a capacity of 3,000 Imperial gallons; each is 1/5 larger than the standard U. S. gallon. The tank fits the standard G. T. P. tender, so that the same oil tank can be used for a number of different classes of engines. The oil in the tank is heated by a direct steam heater.

Live steam from the boiler, controlled by one of the three valves on the firebox end, all of which are readily accessible from the fireman's seat, is conveyed through a ¾-in. pipe and McLaughlin flexible connection on the izer. The type of burner used is the Von Boden-Ingles, the oil connection being made to the underside, 3-in. size being used on small engines and 3½ ins. on wide firebox engines. The regulation of the flow of oil is controlled by a plug cock, with V-shaped opening in the plug, placed at the front of the firebox, immediately under the burner. This cock is operated by a small lever working on a quadrant and fitted on the firebox end so placed that it can be controlled by the fireman without his having to leave his seat.

The brick pans, owing to the engines having sloping

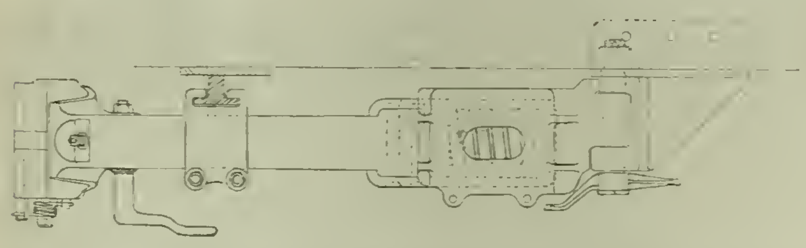
fireboxes, are made to fit up inside the firebox at the front, and the burner is located well above the line of the foundation ring. Air is admitted through two openings, one being around the burner and the other in the boot leg at the back end of the pan, both of which are controlled by dampers. The flash wall is built up to the underside of the fire door, and the seams of the back head and the longitudional seams, between crown and side sheets, are protected with fire bricks. A special fire door has been fitted on, having an inside liner and a 3½-in. hole, for sanding the flues; this being closed when not in use with a swinging cover provided with a peep hole.

The front end arrangements require the short exhaust pipes, and all the dead plates and nettings are removed on small engines, but dead plates have been retained in superheater locomotives and the larger power. An extension is fitted in the base of the stack and a 3-piece petticoat pipe is used. This petticoat is designed so that either the top or bottom sections are independently adjustable. The blowers are of the ring jet and double jet types, cast in the exhaust nozzle. A 3-way cock is provided on the blower pipe at the smokebox for making connection to a round house blower line for lighting up the engine when cold. Steam from the shop line can be used through this connection either to heat the oil in the tank and for the atomizer and superheater, as well as for the blower, or for both purposes at once.

The operation of the oil burning engines will be in the hands of Mr. E. C. Brooks, superintendent of motive power, under the direction of Mr. Morley Donaldson, vice president and general manager of the G. T. P. at Winnipeg. We are indebted to these gentlemen for information on this subject and to Mr. H. R. Charlton, of Montreal.

RAILROAD CARS ON STREET RAILWAYS

There seems to be a growing problem before some railroads in the matter of forwarding freight cars to final destination over street railway tracks containing extremely short radius curves. One case in point is that of a road parallel to the shore of a large lake, and about

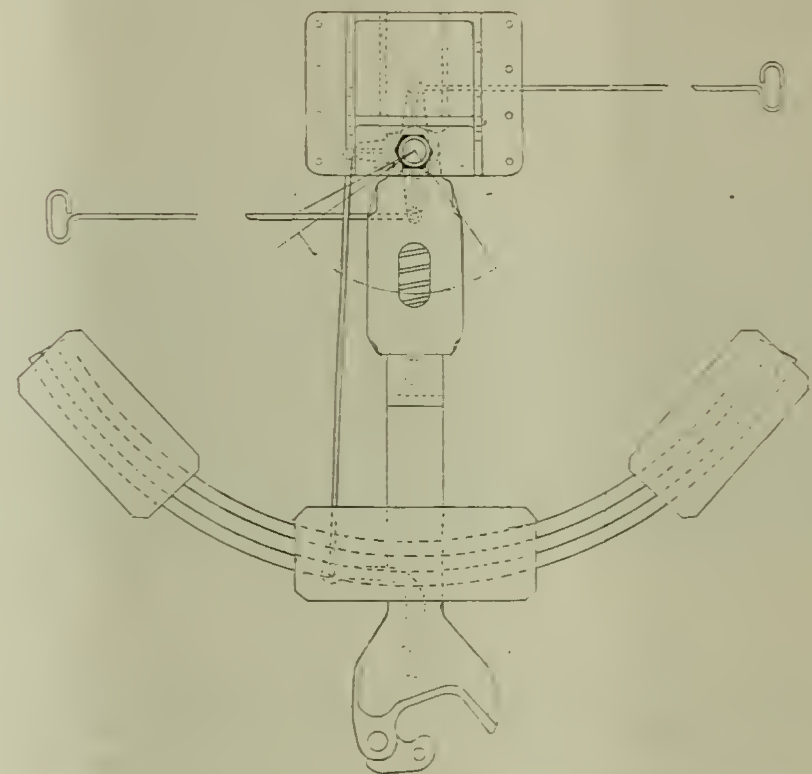


Side View of "Wide Angle" Coupler Made by McConway & Torley, Showing Suspension from Curved Track and Operating Levers.

six miles inland. On the shore are several thriving summer resorts, which can be reached from the railroad by electric lines running to the shore. Any freight to be forwarded must be unloaded and placed in cars of the electric line, because regularly equipped freight cars cannot be operated over the short radius curves of the electric lines. It might be added that there are bulk commodities on which this transfer would cost an amount which would prohibit their use.

A case in point is the shipment of bulk fertilizer from a large packing center to a fruit growing territory. A haul of ten miles is necessary for the farmer if the car is delivered at the nearest railroad siding, and owing to the short time the car will be spotted, the conditions make it next to impossible for the farmer to take advantage of his proximity to the packing center. There are electric lines at short intervals leading out from the railroad and if the originally loaded cars of fertilizers could be forwarded to the farmer over the electric lines he would be much benefited. And the increase in farm productions would result in increase in traffic for the railroad.

If judgment is exercised in the original selection of cars to be used in such service, they can be found of a length which would come within the limit for use on short curves, provided sufficient movement of truck and coupler can be provided. To show how the problem has



Plan of "Wide Angle" Coupler Showing Operating Levers and Side Movement.

been worked out by some roads under these conditions, there is illustrated a radical coupler of over 45 degs. swing each side of the center line of the car. This coupler is pivoted some 4 ft. 6 ins. behind the striking face, and included in this length is a single coil spring rigging to serve as a draft gear.

The wide side movement of the coupler makes impossible the usual carrying iron, and this has been replaced by a carrier in which the shank of the coupler can slide in and out, and which is in turn suspended from a radial inverted "T" track secured to the under side of the car body, thus providing proper support during any coupler movement.

Another departure from standard practice is in the uncoupling device. Again the wide lateral movement of the coupler makes impossible an uncoupling device attached to the end sill, and to meet this problem a device has been worked out by which an arm from the coupler pivot operates the knuckle pin and is in turn operated by a rod from either side, through a bell crank.

This coupler will adapt itself to the use of cars over almost any curves upon which it is practical to run them, and by equipping some cars with such couplers, goods to be forwarded to ultimate destination over lines containing such short radius curves as city street car tracks, can be delivered without expensive transfer from car to car. Traffic may also be stimulated in products where otherwise this element would render freight rates prohibitive.

Curiosity: that is a gift, a capacity of pleasure in knowing, which if you destroy you make yourself cold and dull. Another is sympathy: the power of sharing in the feelings of living creatures, which if you destroy you make yourself hard and cruel.—*The Two Paths.*

The Traveling Engineers' Annual Convention

The twenty-third annual convention of the Traveling Engineers' Association met in Chicago early this month. Mr. J. C. Petty of the Nashville, Chattanooga and St. Louis, president of the association, in the chair. This association, which has done so much to forward the scientific work of "engine running," came into being in 1893. From its inception the Traveling Engineers' Association has been conspicuous for its practical consideration of the various problems which have come before it. Not only have its proceedings been practical, but they have always embraced subjects which were intimately and vitally connected with the art which is the object of the association to promote. The association started with 53 members, and at the last convention upwards of 1,030 names were on the list of membership.

Effect of Valve Gear Design on Fuel Economy and Locomotive Operation.

The first paper to be read was that by Mr. W. E. Preston of the Southern Railway. His subject was the "Effect of Valve Gear Design on Fuel Economy and Locomotive Operation." This subject, as handled by Mr. Preston, is one of considerable complexity, and the paper is rather in the nature of a reference chapter in the literature of steam distribution, than a mere survey of facts. The subject is one for careful study and not for offhand expression of opinion. Mr. Preston did not seek to lead the association into any official advocacy of any one kind of valve gear. The value of indicator cards, how to interpret them and what they mean, was fully and carefully considered. The tendency toward the use of external gears was considered, and the reasons why this is so was also explained. The matter of breakdowns was taken up, and the speaker insisted that in bringing engines in to terminals under their own steam was one which should receive the careful attention of all concerned. In the Walschaerts valve gear very frequently one or other of the sources of motion could temporarily be used to move the valve even if the quantity of steam admitted to the cylinder was not sufficient to develop any great degree of power. This eliminated the danger of an engine stopping on the dead center. A broken combination lever or cross-head link does not interfere with the remaining parts so seriously as to prevent their being used for reaching a terminal. In concluding Mr. Preston said that with new gears, great saving in steam was not to be expected. The argument is, however, that real and lasting improvement is to be looked for more along mechanical lines than in attempts to improve the character of the motion imparted to the valve. While there is a chance for slight saving in fuel, the real economy which may result from the adoption of a better gear is to be found in its lower maintenance cost, and in the greater certainty of its action, rather than in pounds of coal saved. What is most desired in a valve gear is a mechanism which, under the adverse conditions of actual locomotive service, will give to the valve that precision of movement it is designed to have. Along these lines there is ample opportunity to improve present practice.

Prevention of Dense Black Smoke.

"The Difficulties Accompanying the Prevention of Dense Black Smoke and Its Relation to the Cost of Fuel and Locomotive Repairs" was handled by Mr. Martin Whelan, chairman of the committee on this subject.

Some remarks were made on the handling of oil fuel and the smoke that may be caused by it. The conditions of the engine and the manner of handling the apparatus are the principle causes why fuel oil ever does give any smoke. Complete oil combustion is smokeless and the success of the man operating the engine will depend on how closely he is able to obtain the most satisfactory nozzle and draft conditions, considering the fact that the size of the air-openings, as a rule, are not susceptible of much change.

In the burning of oil, the smoke and unburnt gas are caused by incomplete combustion due to either insufficient supply of air or a reduction in temperature owing to its excess. Forcing the fire will produce one or both of these conditions.

The movement of gas mixed with air through the fire box and the tubes is comparatively slow and it is essential that air and gas be properly mixed so as to be thoroughly burned in the fire box before entering the flues. Much smoke is made usually in firing up engines at terminals, due to the tendency to force the fire under these circumstances. If the boiler is filled with cold water and the fire started in an endeavor to get the engine out in 30 or 40 minutes, it is more than likely to result in the forcing of the fire, incomplete combustion and a good deal of smoke.

It may seem somewhat paradoxical to say that where locomotives have come under observation on the same road it has been found that oil burners make more smoke than coal burners. The conditions which prevail and which make or mar the complete combustion of the fuel are in each case practically the same.

The speaker referred to co-operation on the part of all individuals in the mechanical department, the higher officers being no less responsible for the results than are the men who operate the locomotives. Interest and co-operation would cause the heads of the mechanical department to equip locomotives with the best approved smoke-eliminating appliances, such as steam-jets, unrestricted draft openings, properly adjusted front ends, etc.

In dealing with the subject of oil fuel the speaker said that the use of too much brick work in fire boxes reduced the amount of heating surface and that in consequence a higher fire box temperature was necessary than would be required if the brick work was not so prominent.

Location of the burner at least 5 or 6 ins. up the fire box will cause the spray to pass over small objects in the fire box and thus to a large extent prevent the formation of carbon and smoke. The care of the nozzles was most important, as if allowed to clog and become dirty the proper combustion of the fuel was greatly interfered with.

Superheaters as Applied to Lomotives

The "Superheater" question was dealt with by Mr. J. E. Ingling of the Erie. He said, among other things: "The fire-tube superheater has come to be almost universally considered as an essential part of the locomotive. Its success is established. The economy it affords is recognized, and it is, without doubt, one of the most important factors in the development of the locomotive. The superheater equipment has been standardized, and is almost identical on the 12,000 to 13,000 locomotives now operating in the United States and Canada. Its success is largely due to the broad engineering policy of those who

have been interested in the introduction of superheating to locomotive practice, as well as the campaign of education by men thoroughly familiar with the superheater locomotive.

Two important changes have been introduced during the year. These are a modified header design and a continuous pipe or torpedo unit. The construction of the header is such as to prevent the occurrence of stresses due to unequal expansion and contraction, by casting the saturated steam passage-ways free at one end.

The continuous pipe unit is made by forging the return bends on the ends of the unit pipes, thereby doing away with the cast steel return bend and the screwed joints necessary in the assembling of a built-up unit. This unit offers a further advantage in that it reduces the restriction to the flow of gases, so that at no point is the area of the cross-section of the unit greater than four times the area of each pipe. The steam section at the return bend is controlled absolutely so that it cannot be less than the integral area of the unit pipes, and the contour of the bend is such as to offer less resistance to the flow of steam.

The application of the superheater to the small locomotive raised the capacity limit from 25 per cent to 30 per cent. The large locomotive which had reached its maximum on account of the limits of grate, firing capacity, rates of combustion, etc., has been increased by the application of superheaters to its present size, and no doubt other increases will follow in the future. Then, by the adoption of the superheater, larger engines, greater train lengths and faster schedules have been made possible. The advantages evidenced in the various factors of the railroad may be indicated briefly as follows:

Fuel is the largest single item other than wages in the railroad expense account. An engine burning ten tons of coal per day at $2 a ton, working 300 days a year, will burn $6,000 worth of fuel. When large cylinders are used, as in the case of saturated steam locomotives, one of the factors which, as it were, sets the limit, is the fact that in saturated locomotives is the excessive condensation caused by the cooling effect of the large cylinder walls. This is absent in superheater locomotives and the size of the cylinders is only limited by the weights of the reciprocating parts. The elimination of cylinder condensation and the high temperature of the superheated steam make it possible to operate locomotive boilers at lower pressures than is practical with saturated steam. For the same reason that larger cylinders are not feasible with saturated locomotives, outside steam pipes were made possible by the introduction of superheated steam. Outside steam pipes remove obstruction from the front end of the locomotive, thereby facilitating the drafting of the engine, and at the same time bring two ground joints outside of the smoke-box and locate them where, should leaks occur, the vacuum in the smoke-box will not be affected.

Recommended Practices for the Employment and Training of Firemen.

The subject of recommended practices for the employment and training of firemen was taken up at the Wednesday morning session by L. R. Pyle, Soo Line, chairman of the committee. The subject was traced from the early days of railroading when the number of men on a division was small enough for all of them to come in personal contact with and under the constant supervision of the master mechanic and superintendent of motive power. The many benefits obtaining under such conditions included the care that officials took in selecting their immediate subordinates with whom they expected to come into daily relations, the greater opportunity for instruction of these same men; and from the other point of view, the men felt encouraged to take a greater interest in their work, and through their closer relations with officials of the road the rank and file built up a greater spirit of loyalty to the road and interest in its welfare.

Present conditions have brought about a less desirable situation in which it is admitted that less desirable men are being obtained and these men are taking less interest in the road and its welfare. This may be due to the fact that the officials seem to have been growing away from the men—and in the spirit of mutual distrust which has to a greater or less degree resulted from what might be called estrangement, we see one of the greatest needs for improvement in the modern organization.

The paper goes on to recommend that some representative of the high mechanical officials keep in personal touch with all of their men and not let their only contact with their higher officials be through the chairman of their local orders.

As one solution to the problem the committee recommends a systematic programme of education to begin on the first day of a fireman's employment and follow him until as a fireman he receives instructions looking to his being a locomotive engineman in the future. The importance is pointed out of having a man receive his first impressions of a railroad and its management from unbiased and thoroughly reliable sources rather than run the risk of his being prejudiced by some train crew. The instruction period also permits of watching the man and determining his fitness for the position he seeks.

A feature of the report was the showing of several reels of moving picture film illustrating proper and improper methods of firing—and the discussion centered around the idea of teaching enginemen to feel the responsibility of their positions and to appreciate the fact that their interests are in the end the interests of the railroad as a whole.

Following this committee report President C. H. Markham of the Illinois Central Railroad delivered the address postponed from the preceding day, and Frank McManamy, federal chief inspector of boilers, spoke on the recently formulated scheme for inspecting locomotives and tenders.

Scientific Train Loading; Tonnage Rating.

Wednesday afternoon O. S. Beyer, Jr., Chicago, Rock Island and Pacific Railway, took up the subject of scientific train loading, and covered the subject in a very comprehensive manner, setting forth such factors as the best methods of obtaining maximum tonnage haul for locomotives, various methods of arriving at the drawbar pull of locomotives, the factors entering into train resistance, and methods of its determination, as well as approved practices in adjusting tonnage for trains dispatched from any given terminal, and conditions which justify variations from accepted schedules. The convention was also addressed by J. M. Daly, formerly general superintendent of transportation on the Illinois Central Railroad, who has given very particular attention to train haul problems.

This subject was viewed in the practical light of arranging cars and locomotives for the peculiar conditions found on various divisions. It was held to be important to keep the make-up of a train as uniform from one end to the other as can possibly be done, avoiding the preponderance of loaded or empty cars at either end of the train. The length of the train in its relation to the gross tonnage makes it advisable to concentrate the tonnage in as few cars as possible; however, exceptions were mentioned, due to the proximity of curves, crests and valleys in particular sections of track where the exceptions prevail.

The Electro-Pneumatic Brake.

Thursday afternoon the subject of the electro-pneumatic brake was handled by Walter V. Turner of the Westinghouse Air Brake Co., who explained in detail the mechanism, the operation, and the possibilities of this apparatus. Brake action in passenger train service has been perfected by means of the electro-pneumatic brake, to the point where practically ideal conditions are realized. While greater advantages could be derived in freight train service, the problem is not simple, since the supply of electric current is not as readily available in freight as it is in passenger service, nor is freight train brake equipment looked after as carefully as is the passenger equipment. The problem of the application of electro-pneumatic brakes to freight train service, however, is looked upon as being well worthy of an effort at solution, and Mr. Turner anticipated that a satisfactory conclusion will be arrived at.

Improving the Handling of Brakes

Mr. R. L. Pyle of the Minneapolis, St. Paul and Sault Ste. Marie replied in a carefully prepared paper to the question asked in the caption of this day's proceedings. The question was "How Can the Road Foremen of Engines Improve the Handling of Air Brakes on Our Modern Trains?" He said: The efficient manipulation of the air brake and the proper handling of trains under the many conditions of service being properly regarded as one of the prerequisites of a competent engineer, it naturally suggests itself that the maximum effort to that end should not only be productive of higher efficiency from a standpoint of maintenance of equipment and property, but the accomplishment of satisfactory results to the traveling public to whom the railroads owe one of their first duties. Competence in this detail of the engineer's duty. An engineer may be ever so clever in his practical knowledge of the air brake, know every detail feature of construction, its function, relation and operation, but yet be weak when it comes to actual manipulation in train service.

There is no discounting the value of the air brake instruction car, because by it many experiments can be made of the working parts of the system and its detail, that can scarcely be otherwise accomplished. The other side of the problem is none the less an essential factor, namely, the effect braking has upon the train with the many influences introduced by the make-up of the train itself. It is in connection with the influence which train braking and train control has upon railroad operation that the road foreman of engines is of the greatest value in the execution of his many duties.

As a rule road foremen of engines, with their assistants, are practical engineers, have had long and valuable experience as firemen, and should be as thoroughly posted on the air brake, its construction and manipulation as on any other part of the machinery. They should be competent, in a general way, to explain the construction and manipulation of the air brake as instructor or inspector.

The road foreman undoubtedly has a greater opportunity, by reason of his constant road duties, to observe and pick out the men in his territory who will be benefited by special instructions, either as to construction or manipulation; not only to avoid failures on the road, but to point out practices to accomplish smoother braking.

To this end the road foreman of engines has a favorable opportunity to keep before the enginemen on his division a complete and thorough knowledge of the air brake equipment as well as the essential information in connection with its manipulation on the road, which can only be acquired and mastered by demonstration and experience.

The following officers were elected for the ensuing year:

President—J. R. Scott, St. Louis & San Francisco.

First Vice-President—B. J. Feeney, Illinois Central.

Second Vice-President—J. F. Henson, Chicago & Northwestern.

Third Vice-President—W. L. Robison, Baltimore & Ohio.

Fourth Vice-President—Geo. A. Kell, Grand Trunk Railway.

Fifth Vice-President—A. G. Kinyon, Sea Board Air Line.

Secretary—W. O. Thompson, New York Central Lines, E. Buffalo, N. Y.

Treasurer—David Meadows, Michigan Central.

ELECTRIC DEVELOPMENT IN SCANDINAVIA

The most northerly railway in the world, says a recent issue of *Commerce Reports*, has its terminus at Narvik, on the northwest coast of Norway, latitude about 68½ degrees, 130 miles north of the Arctic Circle. This railroad runs east, and then southeast through the principal iron-ore centers of Sweden; thence it proceeds southeast to Lulea, an important port on the Gulf of Bothnia, and connects at Boden with the railroad to Stockholm. Some iron ore is shipped southeast to Lulea, and thence, by sailboats and steamers, to German ports on the Baltic; but the inland port of Lulea, though in latitude 65½ deg. is much more obstructed by ice than the more northerly port of Narvik, in Norway, which is called an "ice-free port." Hence, most of this iron ore moves through Narvik, whence it is shipped to both German and Baltic ports.

The distance from Kjeronavare to Narvik is 110 miles, of which 85 miles are in Sweden and 25 miles in Norway. The Swedish portion of this road has recently been electricified, the current being obtained from the Porjus Waterfall, at a distance of about 70 miles from the railroad. At that point 40,000 horse-power is being generated for railroad purposes and carried by overhead wires at 80,000 volts. It is claimed that the installation of electric drive on this railroad has increased the weight of the possible train as much as 40 per cent. and has increased the speed 50 per cent. The 25 miles in Norway are still steam driven, but present a splendid opportunity for electrification. The southern end of this road, from Kjeronavare to Lulea, is 200 miles long. This may also be electrified in the future.

The scarcity of coal throughout Sweden and the abundance of water power create an ideal situation for an unlimited development of electric generation and transmission throughout the Kingdom. Much interest is being taken in the electric smelting of iron ores, and it is predicted that before many years the shipment of iron ore from Sweden will give place to that of pig iron. Some pig iron is already being shipped to Germany and to England.

There has been a movement in favor of nationalizing the railroads of Spain, especially those supposed to be under foreign control. It is stated that of the $720,000,000 invested in Spanish railroads 60 per cent. represents Spanish capital. The government has aided in the development of the Spanish railroads, with subventions and other pecuniary help, in past years to a total amount of not over $200,000,000, which is lower than is usually supposed by the public.

Underground Electrical Distribution for Shops

By W. E Johnson, Chief Draughtsman W. P. Ry.

With the development of electric motor-drive in shops, the electrical distribution system has come to be the nervous system of the plant furnishing the driving force. Absolute dependability in the electrical supply system is required, and to reach this condition first-class equipment is essential. A few years ago the usual distribution system for all electrical power was by overhead pole lines, but the tendency in city distribution toward underground construction has developed more substantial methods.

Locomotive Shop Yard, Clear of Overhead Wires.

At the present time, standards have been established for underground conduit and cable systems, and these have many advantages over pole lines. The illustrations show the neat appearance of the exterior of the buildings where underground electrical distribution was used exclusively. The absence of the "wire entanglements" and unsightly poles frequently found around shops contribute to the safety of employes and the general appearance of the shop.

The usual practice in heavy underground construction is to build the system of cable ducts complete and pull in the cables afterward. For this type of construction, the kinds of conduit most commonly used are iron conduit or pipe, vitrified tile conduit, and fibre conduit. About the best iron conduit for use without a concrete envelope is a home-made product, consisting of ordinary casing pipe which has been coated on the outside with hot tar, care being taken to see that any parts of the pipe from which the tar has come off are repainted with hot tar before the pipe is covered. A convenient method for coating the pipe is to plug the ends and dip in a long, narrow vat. Ordinary enameled iron conduit corrodes rapidly wherever the enamel is cracked or chipped off, and, in some cases, the enamel peels off on account of corrosive substances getting through and attacking the iron underneath. The zinc on galvanized conduit is thin and is soon destroyed in soil containing corrosive substances. Vitrified tile conduit laid in concrete is almost ideal construction, but it is expensive to install on account of the first cost of the material, the foundation and envelope required, and the labor of installing, due to the short sections. Fibre conduit is made in 5-ft. lengths, with various styles of joints between lengths, and when laid in concrete gives a smooth duct through which cable may be drawn easily, and also lends itself readily to the branching off of single ducts from the main duct system. The fibre conduit is not subject to any corrosive action, and when laid in concrete for mechanical protection, furnishes a permanent cableway at reasonable cost.

Cables for underground work in conduits of any of the types mentioned above should be lead covered, the thickness of the lead sheath being about 1/8 in. on the larger cables and somewhat less on smaller sizes.

The insulation for the conductors and between the conductors and the lead sheath may be composed of rubber, paper or varnished cambric. For small cables, rubber is the most satisfactory but for large cables paper or varnished cambric is more commonly used. The weight of a conductor varies as the square of the diameter while the supporting surface varies directly as the diameter, consequently large cables with rubber insulation are more liable to short circuits due to the conductors settling through the rubber if they should become heated, than small cables are.

Paper insulation requires care in handling to exclude moisture. It is liable to injury at short bends and tends to become brittle with age. Varnished cambric insulation is not as sensitive to moisture as paper is, it will stand rougher handling and does not become brittle with age. It is, therefore, the best insulation for ordinary voltages and sizes of cables.

For distribution to the principal buildings of a shop and where several cables are run near each other, the conduit system as outlined is the best arrangement, but where only one cable is required as to any outlying building some expense may be avoided by omitting the conduit and using armored lead covered cable. These cables, sometimes called "suburban cables," are made up in the same way as the ordinary lead covered cables and are then covered with a flexible sheath composed of two steel tapes which are protected from corrosion by jute and asphalt.

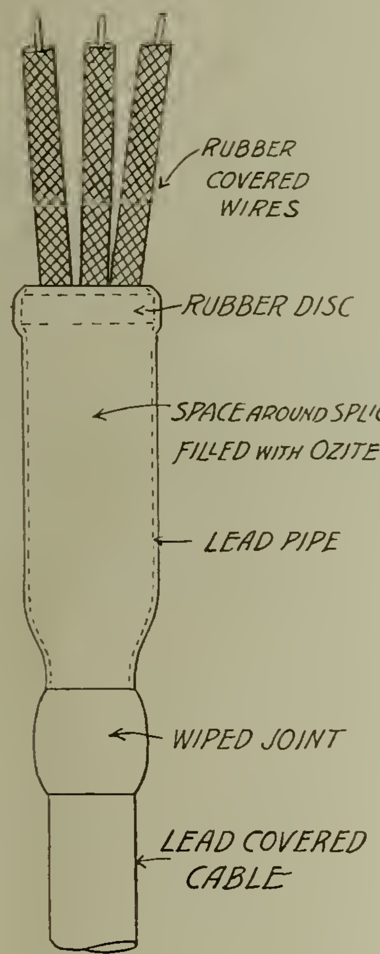
Power House with Underground Wires.

At the ends of all lead covered cables, it is necessary to provide against the entrance of moisture. Where cables terminate out of doors, special cable terminals known as "potheads" are most convenient. These should be of the

disconnecting type for convenience in testing. These potheads may be had for any number of terminals and with various styles of connection to the cable. For the ordinary lead covered cable, the sleeve for a wiped joint between the cable and the pothead should be used, as it insures a water tight job. Lead covered cables for voltages up to 2,200 which terminate inside of buildings and are not exposed to unusual amounts of moisture may be provided with a cheaper home-made pothead as shown in our line cut.

Before beginning the construction of any part of an underground distribution system, a careful study of the present and probable future requirements of the shop must be made so that the work can proceed systematically and so that provision can be made for future additions. In many cases, with overhead construction, wires are run around in all kinds of ways, resulting in networks that are dangerous as well as unsightly. With underground construction, branches must come from predetermined points, hence the necessity for providing in advance, for probable additions.

The electrical distribution inside of shop buildings to the individual machines presents other difficulties, owing to the fact that the machines are set in all sorts of positions and to the fact that the distribution sysem must be under the floor. In order to remedy any trouble such as



Connection Called a "Pothead," for Inside Work.

a "ground" or "short circuit," it is usually necessary to pull the wire out and replace it with new. This makes it necessary to use conduit, and some form of iron conduit is most suitable because of its mechanical strength and the ease with which it may be laid. The ground under ordinary floors is usually damp and sometimes warm so that ordinary enameled or galvanized conduit is liable to be short lived. A coating of hot tar, which can be applied very cheaply, is effective in preventing most forms of corrosion. Probably the best possible iron conduit is the ordinary kind which is galvanized and then enameled on the inside and galvanized on the outside and which is coated with tar on the outside before being laid. This construction is, of course, a little more expensive than some others but is not as expensive as the trouble that can result from flimsy construction.

In the distribution to machines there is also the contingency that machines will not "stay put," but are always

Example of Shop Without Overhead Wires.

liable to replacement or change of location. In the shops referred to, concrete ducts were run across the shop from the main distribution panels and these ducts are perpendicular to the floor boards. The idea is to run a cable to a new machine in one of these ducts from the panel board to a point opposite the machine and then by taking up one or two floor boards the machine can be reached with a reasonable amount of labor.

In blacksmith shops, the trouble with a floor is not met with, but the sulphur in the cinders is liable to form corrosive compounds and destroy unprotected iron conduits very quickly. The coating of tar, as previously described, will be found very effective, preventing this corrosion.

RAILWAY MILEAGE OF THE WORLD.

The railway mileage of the United States, including Alaska with its 653 miles, amounts to 254,870 miles. The earth, being about 8,000 miles in diameter, has a circumference at the equator of about 25,000 miles. The railways of the United States if strung together would, roughly speaking, go around the world ten times.

Germany is quoted with 39,513 miles; Russia in Europe has 38,563 miles; India has 34,572; France has 31,737 miles; the Dominion of Canada is credited with 29,233 miles; Austria-Hungary, 28,641; Great Britain, 23,385; Argentina, 20,593; Mexico, 15,805; Brazil, 15,491; Italy, 10,933; Spain, 9,517; Sweden, 8,984; and Japan, 6,811 miles of railroad.

Looked at from another point of view, the mileage of this continent comes to 335,992, while the other countries mentioned here amount to 232,656 miles. This means that out of the 568,648 total miles of all these countries, the continents of North and South America have more than half the total by about two turns around the world. If the total mileage goes around the earth about 22½ times, America has about 13 windings as against about 11 of the others.

The mileage under British control comes to 87,190 miles, which would give a belt of 3½ coils around the earth's equator. In this resume the Cape-to-Cairo Railway, and indeed the African and Australian railways, have not been counted, nor those of New Zealand, Egypt and the other British territories and protectorates. These would probably extend the last half turn around the world, making four in all, or about 100,000 miles.

A Study of the Railroad Apprentice System

In our August issue we published at some length details in vogue on various important railway lines concerning the apprentice system. Added to this, we now offer other information on the subject, which we think will appeal to our readers.

On the Lehigh Valley

The Lehigh Valley reports that:

There are 97 apprentices employed at the present time.

The age limit is 16 years.

Applicants must be able to pass an 8th grade examination. All things being equal, sons of employes are given preference.

The applicant must weigh at least 120 lbs., and be without any apparent physical defects.

All applicants are required to serve four months' probationary period as material boys before being accepted as apprentices.

The apprentice school is maintained all the year for the benefit of the apprentices of all departments and the apprentices are obliged to attend unless absent from the shop due to sickness or special permission.

There is one apprentice instructor in the school.

There is one demonstrator in the shop.

The school room is equipped with seats and desks for the apprentices. Drawing instruments and paper are furnished for the mechanical drawing classes and textbooks, pencils and paper provided for the mathehatics and mechanics. The school is equipped with a large blackboard and used during the recital period. The balance of the material consists of: A working model of the Walschaerts valve gear and the piston valve and several models used in mechanics to illustrate the principle of expansion of metal due to the application of heat, a parallelogram of forces, etc. The room is equipped with large windows extending from the ceiling to within two feet of the floor and is also equipped with electric lights.

Each apprentice attends school two hours per week.

Apprentices are paid the regular hourly rate while attending school.

The subjects taught are: Arithmetic, mensuration, mechanics, spelling and mechanical drawing.

Instructions are given during working hours.

The apprentice course is four years.

After the four months' probationary period as a material boy, the applicant is put on his time and promoted every four months, provided his work warrants the change.

Ninety percent of apprentices complete the course.

Inefficiency is the direct cause of leaving before finishing their time.

About 80 per cent. remain after completing their course.

About 1 per cent. are advanced to positions of authority in the shops.

The training obtained by the apprentices in their four years' course through the shop fits them for the best positions in any of the departments and they are given preference over new and inexperienced men and if they are better qualified than the older men, they are given preference as vacancies occur in the more desirable positions.

There are no bonuses offered.

Very satisfactory results are generally obtained.

The apprentice courses have proved satisfactory from a commercial standpoint.

A card record is kept.

Two apprentices who have the highest marks for four years are given a year's course, with pay, in the mechanical engineer's office at South Bethlehem. One young man is selected in January and the other in July, so that they overlap, in order that the older can help the one selected last The apprentice having the next highest standing is furnished with a trip pass to any point on the system.

A journeyman's certificate is furnished at the completion of the apprenticeship.

The yearly increase in the number of apprentices has been about ten, but the number now employed is about all can be taken care of with good results, both for the apprentice and the shop.

There is one special apprentice employed.

Not over 25 years of age is the limit.

He must be a technical graduate.

Three years is the length of such apprenticeship.

Two months in tool room; four months in machine shop; three months in air room, two months on rod and link bench; three months in blacksmith shop; four months in boiler shop; six months in car shop; four months in roundhouse; three months in frame and cylinder gang; three months in motion work and valve setting gang; two months on miscellaneous work were the lengths of time covering the segregation.

The object of the course is to prepare for executive positions.

None have completed the course on account of experience gained qualifying them for other positions.

All have obtained positions with other railroads or manufacturing plants before completing the course.

Every inducement is given special apprentices to educate them along practical lines and the only reason for not completing the course is probably due to the care taken to select the best men available and these find more remunerative positions where they can advance more rapidly along special lines.

All special apprentices have proved satisfactory and good results were obtained while the special apprentice remained at the shop.

There is no increase in the number of special apprentices and the railway tries to maintain a force of two.

On the Pittsburgh, Lake Erie and Western.

The Pittsburgh, Lake Erie & Western also furnishes the following:

Fifty-four apprentices employed at McKees Rocks shops. Boys from 17 to 21 years accepted as apprentices. Each to have a common school education, sufficient to enable him to read and write English, to make out his application blank, and to make ordinary computations in simple arithmetic, including addition, subtraction, multiplication and division of four figures, and also a reasonable knowledge of common and decimal fractions. Must pass a medical examination, proving him to be sound physically and mentally; eyesight not less than 20-30 in each eye; free from color blindness, and hearing not less than 20-20. Probationary period of 6 to 20 months.

Boys work in shop before they are accepted as apprentices, and are credited with a part of the probationary

period as they are worthy or when starting their apprenticeship. Have an apprentice school; there is one apprentice school instructor, and one apprentice shop instructor. The apprentice school is equipped with drawing tables, drawing boards and cases for same, drawing instruments, blackboards, testing machine, small lathe, small stationary engine, valve gear model, locomotive parts, and many different models for drawing. Each apprentice attends school four hours per week.

Apprentices are paid their shop rate while attending school; study mechanical drawing and arithmatic; instruction during the day from 7 to 9 a. m.; length of apprenticeship, four years; 95 per cent. had completed apprenticeship up to January 1, 1915.

Dissatisfied with wages and able to obtain journeyman wages in other shops during rush periods, they now and then abandon the shop, but 59 per cent. of the total number of apprentices graduated are still in the service.

Apprentices who have completed their courses may continue in the employment of the company at such rates as their services are worth. No bonus is offered to complete the apprenticeship. No rewards are given for high standings, except preference in promotion. Those who have satisfactory completed their apprenticeships receive certificates signed by the proper officials of the company.

The number of apprentices employed each year was as follows: Year 1902, 1; 1905, 9; 1909, 12; 1912, 25; 1914, 15.

On the Erie Railroad

The Erie Railroad Company furnishes this outline covering its apprentice system:

At the present time, approximately 500 regular shop apprentices employed, which is an average number. Regular shop apprentices must be not less than 16 nor more than 21 years of age; good general health; have a good common school education, sufficient to enable him to read and write English, to make out his application blank, and to make ordinary computation in arithmetic, including addition, subtraction, multiplication and division of four or more figures, and also some knowledge of the simpler forms of common fractions.

Employment is on approbation, and if at the end of three months the apprentice does not develop a capacity to learn the different classes of work in the department in which he is located, he is dismissed. At the expiration of three months, which is the trial period, if applicant has been attentive and gives promise of becoming a good workman, he shall, in connection with father, mother or guardian, execute a regular form of apprenticeship agreement covering the entire term of service.

Educational advantages given in the school cover instruction in the fundamental rules of arithmetic, common and decimal fractions, proportion, simple problems in interest, tables of weights, the elementary principles of plain and solid geometry, mechanical drawing, electricity, machine shop, blacksmith shop and foundry practices, etc.; also instruction in Erie standards pertaining to the construction of cars and locomotives, as well as lessons in the successful and economical operation of same.

There are five apprentice instructors located at the different shops, who serve both as technical instructor in the school and practical instructor in the shops. The school rooms are equipped with drawing tables, drawing instruments, blackboards, work benches, vises, stereopticon moving picture machines, numerous working models of different types of locomtive valve gears, lubricators, injectors, air pumps, etc.; technical magazines and textbooks. The apprentices are required to attend school four hours per week, two hours on each of two different days, for which time they are paid at their regular hourly shop rate. All instruction is given during the daytime and during working hours. The apprentices are required to serve a term of three years of 300 days each, the number of hours worked by the shop to constitute a day. No extra time allowed for overtime. All time lost on account of being absent from work must be made good.

Machine Shop.—Machinists' apprentices are given a general knowledge of all the different clasess of work within the specified time of three years, as indicated in the following schedule: Lathe (bolt lathe first, then general work), 6 months; planers, 3 months; shaper, 3 months; slotter, 2 months; boring mills, 2 months; vise work on rods, 3 months; vise work on motion works, pistons, cross-heads, 4 months.

Erecting Shop—Frame work, shoes and wedges, wheeling engines, putting up spring rigging, engine truck work, expansion gear, etc., 6 months; work above running board (consisting of hand rails, pops, whistles, boiler mounting and all similar work), 3 months; putting up motion work, setting valves, lining guides, putting in pistons, applying steam chests, etc., 4 months. Total in machine shop, 3 years. The tool room and air brake department is now treated as a special proposition, and the maximum number of apprentices are kept in these departments all the time, with the understanding that they are to become specialists in these particular classes of work, as each constitutes a trade within itself. The tool room in the large shops are of sufficient size and capacity to profitably employ at all times from three to five apprentices, and these will be filled by capable young men, to be trained in all the details of the various classes of work.

Tool Room.—Handing out tools, 4 months; operating tool and drill grinders, 4 months; shaper, 4 months; milling machines, 4 months; lathes, 8 months; vise work on die sinking, making and general repairs to such tools as are used on the various classes of work, 12 months. Total, 3 years.

Air Brake Department.—Overhauling and applying brake rigging, 6 months; air pumps, 9 months; engineer's valves, lubricators and injectors, 12 months; reducing valves, cutting out cocks, steam and air gauges, globe valves, water glass and steam gauge cocks, pops and whistles, and all work of similar kind in this department, 9 months. Total, 3 years.

Blacksmith Shop.—Running steam hammer, 6 months; heating bolts, 3 months; helping on small fires, 6 months; running bolt heading and small forging machines, 3 months; light work on small fires with helper, 6 months; helping on tool fire, 4 months; heavy work on open fire not requiring any special skill, 8 months. Total, 3 years.

Boiler Shop.—Heating rivets and helping at light work punch and shear, scaling boilers, etc., 4 months; ash pan and netting work, also as much miscellaneous sheet iron work as possible, 6 months; new firebox work, reaming and tapping staybolt holes, running in, setting and cutting off staybolts, etc., 4 months; helping to scarf, roll, fit, shear, apply rivets and calk new firebox or new sheets, 6 months; setting flues, 3 months; helping on flange fire, 3 months; working with boilermaker on general work such as flanging, riveting, applying new sheets, bracing and staybolt work, 10 months. Total, 3 years.

Tin and Pipe Shop.—Helping on pipe work, 8 months; jacket and sheet iron work, 6 months; injector and lubricator pipes, copper pipes in cab, 8 months; air brake pipes, 6 months; tin roofing, headlights, classification lamps, lanterns, oil cans and light tin work in general, 8 months. Total, 3 years.

Painters.—Helping in general, burning off, mixing paint, 6 months; rough stuff and plain painting, 6 months; sash and varnish work, 6 months; graining, filling and polishing, 6 months; lettering, staining and stripping, 6 months; varnishing and general work, 6 months. Total, 3 years.

Electrician.—Lathes, 4 months; planers, 2 months; milling machine, 2 months; boring mill, 2 months; assisting wire men, 10 months; repairs to motors, transformers, armature winding, 6 months; installation work, 4 months; assisting powerhouse engineers and switchboard attendants, 6 months. Total, 3 years.

Car Builders.—Freight car repairs, including trucks, 12 months; passenger car trucks, 4 months; helping bench carpenters, 6 months; passenger car platforms and general body work, 14 months. Total, 3 years.

Cabinetmakers.—Helping cabinetmakers, 6 months; running machines, 6 months; stripping cars, 6 months; bench work, 6 months; trimming cars, 12 months. Total, 3 years.

Carpenters (Locomotive Shop).—Helping around shop, 6 months; machine work, 3 months; building pilots, 6 months; cab work, 9 months; bench and miscellaneous work, 12 months. Total, 3 years.

Patternmakers.—Helping on general work in pattern shop, 12 months; helping in foundry, 6 months; machine work, 3 months; bench work in general in pattern shop, 15 months. Total, 3 years.

Foundry.—Helping around shop, 3 months; light moulding, 6 months; core making and loam work, 6 months; machine moulding, 3 months; furnace work, 6 months; general work, 12 months. Total, 3 years.

There are many different reasons why apprentices leave the service before completing their course, but probably the most common one is the fact that after serving a year or two of their time they have gained a general knowledge of the trade which they are learning and are offered, what appears to them, a more lucrative position with some outside concern. Approximately 65 per cent. of the graduates remain in the service.

There is no data at hand showing the percentage of graduate apprentices who have been advanced to positions of authority in the shops. Graduate apprentices are encouraged to remain in the service from the fact that they are always given preference for positions of advancement over applicants from outside concerns. The latter statement is borne out by the fact that many of the foremen, also a few general foremen and higher officials, are products of these schools.

There is no bonus offered to apprentices completing their apprenticeship. The results obtained from present apprenticeship system fully justify its maintenance, as through it the company is recruiting their shops with first-class mechanics, who are trained and educated in the Erie standards and methods, and, as a general rule, these men are loyal to the company and have its interests at heart.

A careful record of each apprentice is kept, covering his class and shop work, on special forms provided for this purpose at the end of each month. This record is made up showing the number of days worked in the shop, the number of classes missed, efficiency of the apprentice on his shop work, his standard in drawing, mathematics, personality, etc., and forwarded to the superintendent of apprentices to be incorporated in the permanent records of his office. Apprentices having high standing in their shop and class work are given first chance for promotions as a reward for their good work. Upon finishing the regular apprenticeship course, all apprentices are given a certificate, also a copy of general text book used in the schools.

Special Apprentices on the Erie

This company aims to keep in its service from 25 to 50 special apprentices. Special apprentices are employed without regard to maximum age limit. In order to become a special apprentice with this company, an applicant must have completed a special mechanical course in some one of the recognized technical colleges. Term of service will be three years of 300 days each, unless qualified in a shorter period.

Locomotive Department.—Erecting shop, 6 months; machine shop, 6 months; boiler shop, 4 months; blacksmith shop, 4 months; vise work, 4 months; roundhouse, 6 months; special work, either on line or in test department, 6 months.

Car Department.—Freight repairs, to include wood and steel car work, 6 months; mill work, 3 months; passenger car platforms and general body work, 12 months; paint shop, 6 months; helping cabinetmaker, which will include stripping and trimming cars, 6 months; bench work, 3 months.

The object of this course is to afford technical graduates a chance to learn by actual experience the practical side of railroad work, thereby fitting themselves for a position of trust and responsibility. They are encouraged to remain in the service by the fact that the management always endeavors to promote such graduates as have proved themselves capable and deserving to positions of trust and responsibility. Special apprenticeship courses have proved satisfactory both to the company and to the apprentices. The company has developed and now has in its employ quite a number of valuable men who finished special apprenticeship courses, and even though the apprentice should see fit to leave the service upon completing his course, his time has been well spent, for he will have obtained such valuable experience that he will be able to command a position in the outside mechanical field.

THE AMERICAN LOCOMOTIVE COMPANY

Under date of September 8, 1915, the report of this company for the year ended June 30 last shows gross earnings of $9,303,298.23, as against $29,987,438.25 for the previous year. This enormous decrease of over $20,000,000 for the year shows to what extent the railroads have gone in the way of retrenchment, and at the same time it is evidence of what the railroads must do when the time comes to make good these economies. This time is approaching, and all the equipment companies in the country will eventually be greatly benefited as a result. With economies in operation, the locomotive company showed a net loss only of $1,491,980.43, as against a net profit for the preceding year of $2,076,127.45. At no time during the fourteen years of its existence has the company suffered so severe a depression in its business. Since April of this year, however, large foreign orders have come in, and in addition to these, locomotive orders amounting to $5,838,235, as compared with $4,162,356 on June 30, 1914, have been booked. The outlook for the coming year is decidedly promising. We congratulate this great establishment on its prospects.

NEW TYPE GASOLINE MOTOR CAR

This new high-power car is a 70-ft. baggage, mail, express and motor car, equipped with a 300 horse-power engine and has power capacity sufficient to haul a standard steel railroad coach as trailer, making a double unit motor-car train which will have all the facilities and capacity of a steam propelled train, and can therefore be substituted for the ordinary five unit train, consisting of a locomotive, tender and three passenger cars.

Mr. A. L. Mohler, president of the Union Pacific Railroad, has from the original conception of the gasoline motor car advocated and believed in the higher powered cars, and this new 300 horse-power engine was designed to meet his views.

The baggage, mail, express and power, all on the same and leading car, is a new idea, and is the conception of Mr. Charles Ware, general manager of the Union Pacific. Mr. Ware's idea is to have this new 300 horse-power car and coach afford all the facilities of the usual local and branch line train. The past ten years' experience in operating gasoline motor cars has shown such an increased business, due to their use, that even with the growth (from a 30-ft. car at first to the present 70-ft. passenger and power car hauling a 30-ft. trailer) the size of the gasoline equipment had to be further increased and the new double unit was designed in consequence.

Large revenue capacity in connection with low dead weight, high acceleration, the facility (on account of light weight) in making local stops, all tend to very much improve the economical results in handling passengers, mail, express and baggage on main line locals, as well as branch line trains. Great economy, lessened depreciation, high speed, satisfactory earning capacity and the gain of the public good will, are some of the advantages claimed for this double gasoline unit.

On the initial trip the car attained a speed of 55 miles an hour. Union Pacific Car No. M-23 went into service between Kearney and Stapleton, Neb., as a substitute for the formerly used steam train. The distance is 103 miles, making the round trip of 206 miles a day, which results in a monthly average mileage of something over 6,000 miles, which compares favorably with the average monthly mileage of passenger locomotives. The seating capacity of the motor car train is 78 passengers, while that of the steam train was 70.

The smooth riding of the car, the absence of smoke and cinders, the heating and ventilating system is worthy of note. These advantages, combined with the high average speed, notwithstanding the flag stops at all highway crossings, have steadily helped to increase the popularity of this service.

The McKeen type "D" 300 horse-power reversible engine truck is an enlargement of the model Type "C" 200 horse-power motor truck, the present standards and design being the result of ten years' experience in the practical operation of gasoline motor cars. The engine is reversed by air pressure mechanism, the controller of which, together with the throttle, is placed on the right hand side of the engine, thus enabling the motorman to remain seated while observing signals and operating the car. Weight on drivers is 33,800 lbs.; tractive effort, 8,200 lbs. Some of the main dimensions are: Length, 70 ft.; length of U. S. Ry. P. O., 15 ft.; length express-baggage compartment, 38 ft. 3⅜ ins.; total wheel base, 44 ft. 2 ins.; wheel base, front truck, 10 ft.; wheel base, rear truck, 7 ft.

Gasoline Motor Propelled Train on the Union Pacific Railroad.

EXTENSIBLE TRAP DOOR FOR COACHES

The Pennsylvania Railroad Company has built at New York Terminal, Manhattan Transfer, Rahway and North Philadelphia what are known as high station platforms, and has under construction similar platforms at Wilkinsburg and Johnstown, on its Pittsburgh Division. The adoption of the high platform by this company is in line with its policy of obtaining good railroad features. The advantage of the high platform is simply that it avoids a step; but a difficulty has arisen where the platform is built on a curve, as a gap then comes between the end of car and the platform. The physical conditions at many stations, of course, make it impossible to build tangent platforms.

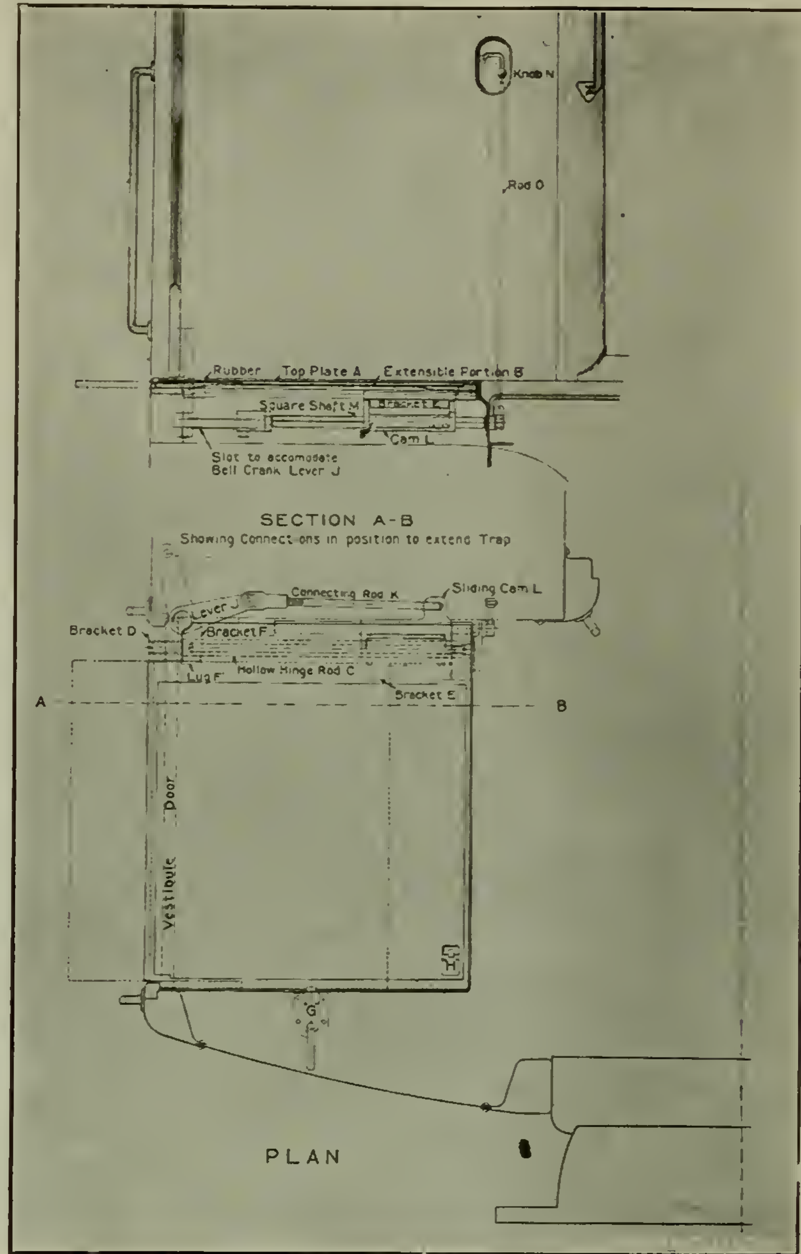
The P. R. R. has equipped for trial a steel vestibule car with the Sickels Extensible Trap Door, as shown in our illustrations, designed to bridge the gap between the car and the station platform.

When the trap is down, the opening of the vestibule door causes the sliding portion to come out underneath the trap, the closing of the vestibule door returning the slide to where it was before. This arrangement is designed in view of the fact that the extension and the trap may be reqiured for use at the same time, along with the opening of the door, and, as the vestibule door is required to be closed on leaving station, the extension must necessarily go in at the same time. Furthermore, the physical effort required to open the vestibule door is utilized to move the extension.

There are certain times when the extension should not be out when vestibule door is opened, as in the case when trap is to be raised for use of steps, or when brakeman opens door while train is moving. To provide for this contingency an ingenious, but simple arrangement is provdied, by which the connection can be thrown out of gear by means of a small handle set flush in the side of the vestibule and placed at a convenient height. It is not necessary with this arrangement to have extra trainmen to attend to its operation, as, with the small hand lever set in the proper position (which is done by brakeman before train reaches station) the opening of the vestibule door, whether accomplished by trainman or passenger, will cause extension to slide out into the safe position. Owing to the fact that the trap or top plate does not move, it is, of course, impossible for a passenger to be thrown down by movement causing the extension to operate. It is also impossible for a passenger to stand on the trap while vestibule door is being opened.

The trap is, in outward appearance, like the ordinary trap, and consists of a rubber covered top plate, and the extensible portion is made panelled pattern. It also acts as a support for the top plate, the two parts being hinged on a hinge-rod, so that they act together when trap is raised for the use of steps.. The hinge rod is hollow, and accommodates the flat springs which are adjusted at the bracket so as to obtain the proper tension necessary to raise the trap. The extensible portion is supported by means of a bracket, which slides on the hinge-rod, and by means of a lug, attached to top plate bracket. When the extension is out, owing to the fact that it is supported at one side on a lug, and at the opposite side on the usual angle iron ledge, the extended portion cannot deflect when a passenger steps on it. The usual spring catches are used respectively to hold trap down when door is closed and to hold it up against the vestibule door when trap is raised for use of steps.

Door Open, Trap Down, Extension Out.



Plan of the Trap Door and Extension.

The operating device consists of the bell crank lever attached to the vestibule door, the connecting rod, and the cam, which slides on a square shaft. When this square shaft is tilted to place, the sliding cam is in the "off" position, the opening of the vestibule door simply causes the cam to slide on the shaft without any effect on extensible portion. The square shaft is tilted by means of the small knob on the end of the rod, which is attached to lever at one end of the square shaft. When the square shaft is thus tilted, the sliding cam comes up in the back of the tapered bracket on the trap, so that when door is opened the sliding part is extended. The sliding cam is designed so that whether in the "on" or "off" position, the front finger on it is always in a position to hold in the extensible part, so that it is absolutely impossible for the extension to be out with the door closed. The trap is arranged so that it is impossible to raise it when extension is out, thereby preventing the obstruction of the hand rail at side of car.

The device is designed with a uniform extension to suit the gap at platforms built on as sharp a curve as 6 degs. On lighter curves the extension may overlap the platform an inch or two, the station platform, of course, being kept a slight distance below the floor of the car. Owing to the varying heights of the car floors above the

top of rail, due to weak springs, or original construction, it has been found impracticable to maintain the car floor on an exact level with the station platforms. The design is protected by patents.

ELECTRICAL EQUIPMENT, MAINTENANCE AND OPERATION

The report on electric railroading, of which Master Mechanic committee Mr. C .H. Quereau was chairman, is in brief form as follows:

In order that the members may have an adequate idea of the extent to which steam railroads have been electrified, a table, corrected in Jan. 15, 1915, has been prepared. Summarized, it shows electrification on parts of fourteen steam railroads, to the extent of 591.3 route miles, including 1,761.65 miles of track. While this constitutes a very small percentage of the total steam railroad mileage, the figures probably exceed most of the informal estimates made by motive power officials, and to this extent they are impressive.

The table shows that for nearly ten years electricity has proved its ability to handle successfully a heavy and exacting traffic, and the experience gained has demonstrated the fact that the only question to be settled for farther electrification is "Will it pay?" This is a question which can be wisely answered only by a detailed study of each problem proposed, made by competent electrical engineers.

In general, the committee considers that experience in maintaining steam equipment is the best possible training for the new responsibilities, about the only additional requirement being an ability to understand and use intelligently the necessary electrical terms. This is not difficult.

A feature worthy of note in connection with the maintenance of steam and electrical equipment will be found in the comparatively small machine tools and light cranes installed in electric locomotive repair shops. The reason for this is the relative lightness of the individual parts of the electric locomotives. Another feature is that, on the average, the age of the employees in an electric equipment shop is less than in a steam equipment shop. One reason for this is that the maintenance of electric equipment on steam roads is a comparatively new business, and has been in existence too short a time to have employees grow old in the service. It is undoubtedly true that the older men are more awed by the, to them, unknown problems of electricity, and they prefer the security of their old positions, which they are sure of filling capably, to the uncertainty of what they consider a new field. On the other hand, the fact that the new positions are connected with electrical apparatus appeals to the imagination of the younger men, who have less to lose and more to gain in the new work. The fact that younger men are attracted is not a disadvantage. One might easily assume it is essential that the workmen have a rather extensive electrical training, and it is true that a maintenance organization should have one or two electrical experts, mechanics rather than engineers. Experience has shown that at least 90 per cent. of the work to be done and of the efficiency of the equipment and its maintenance the unit "Miles per Detention," and also the unit "Miles per Minute Detention," are required, but the majority of statements published do not show the former item.

For the operating officials the unit "Miles per Minute Detention" is of decided value, but this is not the proper basis on which to judge the efficiency of the apparatus nor of the force that maintains it, because the length of the delay is affected in most cases more by operating conditions than by the nature of the failure originally causing it.

A few illustrations will probably make the point much more clear than an extended argument. In three cases on one electrified road detentions due to broken tires were respectively 38 min., 60 min. and 92 min. Inasmuch as the length of the train delay due to the single class of failure varied from 38 to 92 min., it makes the unit, "Miles per Minute Detention" of absolutely no use to the superintendent of electric equipment. The fact of importance to him and to those who are interested in the efficiency of the equipment is that the tires broke. Including the length of the delay only confuses matters.

A few days' instruction by a qualified traveling engineer and a few trips over the road under his supervision are sufficient to instruct the men. A little consideration will convince even the most skeptical that a knowledge of the Book of Rules, the significance of signals and train orders, experience in handling the air brakes and an intimate knowledge of the territory constitute at least nine-tenths of the qualifications of an efficient engineman.

There is this characteristic difference between steam and electric equipment. With steam locomotives it takes about five minutes to locate a defect and from a day to a week to make repairs; with electric equipment it takes an hour or two to locate the cause of the trouble and from five minutes to a day to repair the defect.

It appears to be advisable, therefore, to consider only the unit "Miles per Detention" in connection with the records of the maintenance department, and it seems also to be desirable to subdivide the causes of train delays due to electric equipment under three headings: "Man Failures," "Electrical," and "Mechanical." The headings "Elecrical" and "Mechanical" are self-explanatory. The heading "Man Failures" is intended to cover failures of equipment which are due to the men operating it. Examples may be cited as follows: A delay of eight minutes because of blown shoe fuses on the locomotive was caused by picking up a piece of wire that had been left on the right of way; a train was delayed five minutes because a heater fuse blew and one of the train crew pulled the main switch, which was not necessary; a train was delayed four minutes because the yard inspector did not replace the jumpers between cars after completing his work on these cars.

Obviously, such items as these should not be included in the statistics by which either the equipment or the force responsible for maintaining it are judged, although they should be included in the delay statistics for the benefit of the division superintendent and other operating officials.

BULLETINS ABOUT NATIONAL TUBES

The development of the pipe business has been so rapid that reliable literature on the subject has been scarce. "National" bulletins represent the endeavor of the National Tube Co., of Pittsbugh, Pa., to produce such educational literature. Twenty bulletins have already been issued on various phases of the pipe industry. For titles see National Bulletin No. 20, pages 31-32, obtainable on request. This bulletin is an index in detail, the idea being to offer information on the questions of pipes and have it readily accessible to the busy man. We will be glad to have our readers ask for and examine this bulletin, and would further ask anyone to make such comment or criticism as may occur whereby the end in view may be more readily attained; that is, to make available the information about pipe which is to be found in previous National bulletins. Ask for Bulletin No. 20, and then decide what further information you require.

DYNAMIC AUGMENT

In the report of the committee of the Master Mechanics' Association on Counterbalancing, three phrases occur which are capable of a little closer definition than that given in the report. Of these there is what is called the *Dynamic Augment,* the *Diameter-speed,* and the *Overbalance.*

Dealing with these we must first point out the matter as handled in the report. It says:

"In order that the subject may be readily comprehended, the entire report will deal only in simple terms and will present the subject-matter without introducing the use of elaborate formulæ and other technicalities. The main principles involved were illustrated in several diagrams (not here reproduced). In these, the radius of the circle represented the centrifugal force of the weight added to partly counterbalance the reciprocating parts. The revolving parts were assumed to be perfectly balanced, so that the weight added need not be considered. The weight added for partly balancing the reciprocating parts is the *overbalance,* which distorts the action of the otherwise perfectly balanced revolving parts."

Here then is the "overbalance," or weight intended to help smooth the action of the reciprocating parts, but it disturbs the work done in balancing the revolving parts.

Bearing in mind what the overbalance is, the report says: "The overbalance which is used to counteract the desired portion of the weight of the reciprocating parts should be distributed as nearly equally as possible among all driving wheels, adding to it the weight of the revolving parts for each wheel. This sum for each wheel, if placed at a distance from the driving wheel center equal to the length of the crank, or a proportionally less weight if at a greater distance, will be the counterbalance required."

The weight figured for the revolving and reciprocating forces is usually taken at a speed in miles an hour equal to the diameter of the driving wheels in inches. Thus a 50-inch wheel used in this way would be calculated as if the engine was moving 50 miles an hour. This figure is called the *diameter-speed.*

At this speed the reciprocating parts, due to the laws of inertia, tend to continue their motion at the end of each stroke with a force about equal to 40 times their weight. This is the "dynamic augment," and it varies with the stroke. It is a mathematical expression, for a particular case, of the physical effects of the law of Inertia.

The overbalance exerts a centrifugal force equal to about 40 times its weight, and is at a maximum at the top and bottom position of the crank. This force is added to the static weight, or standing wheel load, in the lower position of the overbalance, and is opposed to this weight, in the upper position. Approximately one-fortieth of the static weight on a wheel will therefore give the weight of the reciprocating parts which could be balanced without causing the wheel to rise from the track at diameter-speed. This amount of balance would also double the load on the rail when the balance is down.

In order to calculate this dynamic augment it is necessary to know the overbalance at the speed-diameter and multiply it by a figure found in practice for the length of stroke. As an example, the dynamic augment for a 26 in. stroke would be 41.7 times the overbalance at the diameter-speed.

The terms *Diameter-speed,* and *Overbalance,* are easily understood, but the *Dynamic augment* is not so clear. It is variously called, some refer to it as the disturbing effect of some weight applied, which is put there to endeavor to balance reciprocating motion on a revolving wheel. A revolving wheel alone can be comparatively easily balanced, so can pure reciprocating motion, as in the walking beam of the steamer. It is when one tries to balance reciprocating motion on a wheel that the difficulty begins.

One large concern defines "Dynamic augment" thus: "It is the increase of the force exerted at the rail by the momentum of the reciprocating parts." Another speaks of it as "representing the dynamic force of the overbalance which is added to the wheel to partly balance the reciprocating parts. This dynamic or centrifugal force must be added to the static force, or weight on the wheel, to get the total force on the track."

The reason that the dynamic augment varies with the length of the stroke is that the centre of gravity of the counterbalance in the wheel remains practically in the one position, while if the stroke is altered, the reciprocating parts have farther to move each stroke, and so develop more momentum. This increase no doubt follows some law; as the stroke varies, and therefore the calculated dynamic augment has to be multiplied in each case by some coefficient peculiar to that particular length of stroke.

The report concludes with a rule for counterbalancing which the committee believes to be much more simple than the one generally used, and consequently more satisfactory.

"A simple counterbalancing rule expressed in general terms, which should give good average results when applied to any class of locomotives in any service, might be stated as follows:

Keep the total weight of the reciprocating parts on each side of the locomotive below 1-160 part of the total weight of the locomotive in working order, and then balance one-half the weight of the reciprocating parts.

The above general rule is based upon diameter speed, and should keep the dynamic augment well within the limits of good practice. The "augment" is practically the tendency of the reciprocating parts to keep on moving when once in motion, and a force is required to stop them, in order to have them move in the opposite direction. Where the normal speed is regularly considerably below the diameter-speed, it may be desirable to increase the proportion of the reciprocating weights to be balanced to as much as 60 per cent. or 65 per cent.

Another counterbalancing rule is, to set an arbitrary percentage which the dynamic force of the overbalance will be allowed to increase the static weight; for example:

If it is desired that the dynamic force of the overbalance at diameter-speed should not increase the static weight on a wheel more than 50 per cent., calculation could be made as follows:

4-4-2 type locomotive with 26 in. stroke.

Given: Static weight on one wheel = 30,000 lb.

To find: Maximum permissible weight of reciprocating parts to be balanced in one wheel = W.

$$W = \frac{\text{50 per cent. static weight on one wheel} \times .312}{\text{Crank radius in inches.}}$$

$$W = \frac{15{,}000 \times 312}{13} = 360 \text{ lb.}$$

Therefore: The total reciprocating weight to be balanced on one side of this locomotive would be 720 lb. And with 50 per cent. of the total reciprocating parts balanced on one side, the total weight of these parts must be designed to weigh 1440 lb.

The converse of this is:

Given: Weight of reciprocating parts balanced in one wheel, W = 360 lb.

To find: Dynamic augment = A.

$A = W \times 3.2 \times \text{crank radius in inches.}$

$= 360 \times 3.2 \times 13 = 15{,}000$ lb.

Therefore: 15,000 lb. dynamic weight is added to the 30,000 lb. static weight, giving a total of 45,000 lb. on the rail.

Efficient Handling of Material in a Railroad Car Shop

By C. L. Bundy, General Foreman D., L. & W.

Railroads like individuals acquire money or its equivalent by economical expeditures of money. This requires what might be called team play by all concerned and there is no department on a railroad which offers a wider field than either the stores or the mechanical department to bring about the desired results. These departments are closely allied, one depending to a large extent on the other, and in considering this subject the two departments must be kept in mind.

The mechanical department cannot succeed in getting out the maximum output unless there is an efficient stores department ready, willing and capable to do its share. It requires a thorough organization of the two departments. The storekeeper should be able to watch all the standard run of materials and keep up the stock without the assistance of the different department foremen, but there is a good deal of material that he is unable to keep in mind unless the different foremen co-operate with the storekeeper. Therefore, a good reliable organization is the first necessity in a well regulated shop.

The chief ends to be attained are as follows: First, That the smallest amount of money be invested in material consistent with the economical operation of the shops. Every dollar invested in material over the actual amount required is a tie up of the company's capital. Second, Proper care must be taken of all material while in the hands of the stores department.

In order to operate the shops on an economical basis and on a minimum investment of money in material, it is necessary for requisitions to be made promptly each month and put through to the various officials whose signatures are necessary so as to have the signed requisitions reach the purchasing agent with the least possible delay so that he may be able to purchase the supplies as soon as possible. As a general rule, monthly requisitions are sufficient, with the exception of special work which requires special requisitions.

The storehouse should be conveniently placed with reference to the other buildings so as to reduce the cost of handling material from the storehouse to the point where it is to be used. In addition to the general storehouse, small storehouses should be maintained in the passenger car repair shop and freight repair shop. The foreman in charge should see that all castings and other items requiring machining are promptly done and put by, for ready use when wanted. Each of these should carry in stock the general run of material used in that department. A close check of materials used in each shop for a period of say three months back should be a good criterion for placing requisitions for future requirements as work does not vary to any great extent for one month to the other. There is special work to do in all shops requiring special material and these cases must be handled as they appear.

Storekeepers always desire to fill all requistions received for material from the different department foremen, yet in many cases they are unable to do so. All unfilled requistions should be delivered to the storekeeper once each day. It should be his duty then to follow these items and obtain a supply of each kind he is out of as soon as possible or let the man ordering know what to expect.

I have found it to be the best policy to have special men deliver material from the storehouse to the different departments. It does not pay for a workman to stop his work to go for material when a laborer can do it just as well. It should be the duty of these material carriers to watch the work on different cars as it progresses and keep the men supplied with the material they need. Special material such as is wanted for foreign cars should be handled by the foremen in charge of the work. When any odd forgings are wanted he should furnish a sample or a pencil sketch to the foreman of the blacksmith shop. If castings are to be ordered he should furnish a list showing car number and initial, the kind and pattern number as well as the number of pieces wanted. Any lumber needed should be ordered from old timber as a sample or by the size.

Material in the general storehouse should be classified and each section be in charge of a man familiar with all the material kept in his section. As an illustration, one section should be set apart for passenger car brass trimmings, such as door locks, hinges, sash locks, trap door fixtures, lamps and all other parts of this kind used on passenger cars. It depends on the size of classifications for material. In a shop handling only passenger cars and locomotives, twenty classifications would be sufficient, while in a general storehouse supplying all departments of a railroad it would require possibly thirty or forty classifications. It should be the duty of the man in each of these departments to fill orders and to report to the storekeepers as to ordering a new supply with a view of being able at all times to have sufficient material to meet all requirements. Heavy material such as truck or body bolsters or material of like character should be unloaded in the car shop where it is to be used and if for some special cars or special work, it can be charged out from the shipping invoice.

In all large shops there is a great amount of good second-hand material. This should be taken care of and saved for future use. Material of this character should be kept in a place provided for it and in charge of a man who will keep the storekeeper posted as to what he has in stock. A credit should be made of all material when it is placed in stock and charged out as it is used at a price of about one-half of its original value.

I have always found it to be the best policy to make up such forgings as arch bars, draw bar pockets, carry irons and other forgings of like character that are made on the bulldozer or upsetting machines in reasonably large quantities, say sufficient to last sixty days, as it costs only slightly more for labor to make 100 pieces than it does to make 25, most of the expense being in setting up the machine for the work. This same rule applies to the wood mill. All standard material, such as draft timbers, dead woods, siding and lining and many other items, should be run in quantities sufficiently large to always have them on hand all finished.

In piling lumber one end of the pile should be elevated, say about 1 to 12 ins., and each strip separating the courses be placed directly above the one below. Such lumber as poplar, used for passenger cars, should be allowed to stand in the lumber yard and thoroughly air dried for about six months, and just prior to being used placed in the dry kiln for about eight or ten days, then taken out and dressed. This applies to many kinds

of lumber used in connection with passenger car work. All lumber after being piled in the yard should be painted on the ends to prevent cracking.

The lumber yard should be provided with a self-propelled crane to unload and load material from cars. The lumber yard foreman should deliver to the mill all lumber ordered in by the mill foreman and should charge it to the particular job it is to be used on. Some roads make a practice of milling all lumber in connection with passenger car or freight car repairs on a monthly stock order. This makes less clerical work in the lumber yard and in the mill.

The rehandling of material should be avoided as much as possible as it costs money to handle it. For example, couplers should be unloaded at the point where they are to have the pockets riveted on. Wheels and axles should be unloaded as near as possible to the point they are to be mounted. This condition applies to many items of material and it is no small task to organize a gang of men to do all the work connected with unloading and loading. For moving material about there should be a gang of men at the scrap bins to unload and separate the different kind of scrap. One man of this gang should be capable of detecting good material that might be sent in by mistake. There is always more or less serviceable material that goes to the scrap bins in all shops.

In the handling of materials in a shop repairing passenger and freight cars and locomotives the forces should be divided up into separate gangs. One gang to be stationed at the storehouse unloading and loading material, one in the locomotive shop handling such material as should be unloaded and loaded in that department, one in the lumber yard unloading lumber or delivering lumber to the mill, and all work in connection with that department, and one gang to take care of the work of handling material in the freight shops and yards, and one gang to look after the passenger car repair shop.

I also desire to call attention to the importance of "a place for everything and everything in its place." When cars are stripped each part removed should be put in the proper place and followed up. This is important as it means delay to the car in case any part is lost. I would also recommend in passenger car work tagging such parts as grab handles and water coolers, showing car number they belong to. This saves delay and it does not cost much.

It is also important that the shops and yards are equipped with industrial tracks about 3 ft. gauge connecting the storehouse with all departments of the shops. In the freight shop tracks should be provided between every track and in the passenger car repair shop between every other track. All the cars used in connection with these industrial tracks should be light, so as to be easily handled. Others should be substantially built to carry heavy loads to and from the mill and the heavy material in the locomotive shop. It will be found that much material, such as bolts and nuts, etc., in all shops can be delivered from the storehouse to the shop in an ordinary wheelbarrow. The whole matter resolves itself into a case of good, systematic handling of all material; and it takes time and patience to organize the forces which will give the desired results.

The Southern Railway have awaraded the contract for changes and alterations at Spartanburg, S. C., to the Willard-Boggs & Company, at Spartanburg and the contract for the installation of a new heating system, to the Poe Hardware & Supply Company of Greenville, S. C.

RELIEF ASSOCIATIONS

Many of the larger railroad systems have in vogue some plan of insurance for their employes. By comparatively small contributions each month on the part of the men, provision is made against the time when sickness may overtake them, or, in case of death, against a possible empty treasure box at home.

This scheme of relief is most creditable, and the custom of organizing associations of this character on the railroads is becoming more general. Few small railroads —those whose employes may not number more than 3,000 or 4,000—have such associations in vogue. It might seem at a glance that, as there are a limited number, comparatively, in such instances to contribute, the plan might fail either to be self-supporting or, more important still, to result in a surplus or reserve fund. There is one road in this last mentioned class, however, upon which for thirty years there has been established an employes relief association. It stands today upon a most substantial financial basis, and has all these years served its purpose amazingly well. When this association was organized the only railroad in the country which could boast of an institution of this kind was the Baltimore & Ohio.

Under careful management and by reason of skilful attention on the part of its secretary, who has held this office for years, *"The Long Island Railroad Employes Mutual Relief Association"* has prospered, and bids fair to continue to prosper for many years to come, furnishing comfort and relief to many a man and household.

Last year employes and their families benefited by this assocation to the amount of $70,932.78. Eighty members died—61 from natural causes and 19 by accident. Of the members incapacitated for work in 1914, 635 were sick from natural causes and 620 sustained injuries.

The association has a cash balance or surplus of $45,443.61. The ordinary operating expenses of the association are paid by the railroad company. There is a committee of Management, elected by the members from among the employes, to which the railroad company adds, by appointment, other members, who may be officers or heads of departments. Such organizations do good, encourage employes to be provident, and are a great source of relief in time of trouble.

DEPARTMENT OF CHEMICAL ENGINEERING

Courses leading to the degree of Chemical Engineer have been offered in the department of chemistry of Columbia University for the past ten years. Now, in recognition of the rapidly increasing importance of such industries as are based on the application of chemistry and the consequent demand for men specially trained in the fundamental engineering practices as applied to the problems of industrial chemistry, the trustees of Columbia University have established a separate department of chemical engineering. This has been founded on the same plane of importance in the Columbia Graduate Engineering School as mining, civil, electrical and mechanical engineering. The head of the new department will be Professor M. C. Whitaker, who has been professor of chemical engineering at Columbia University for the past five years.

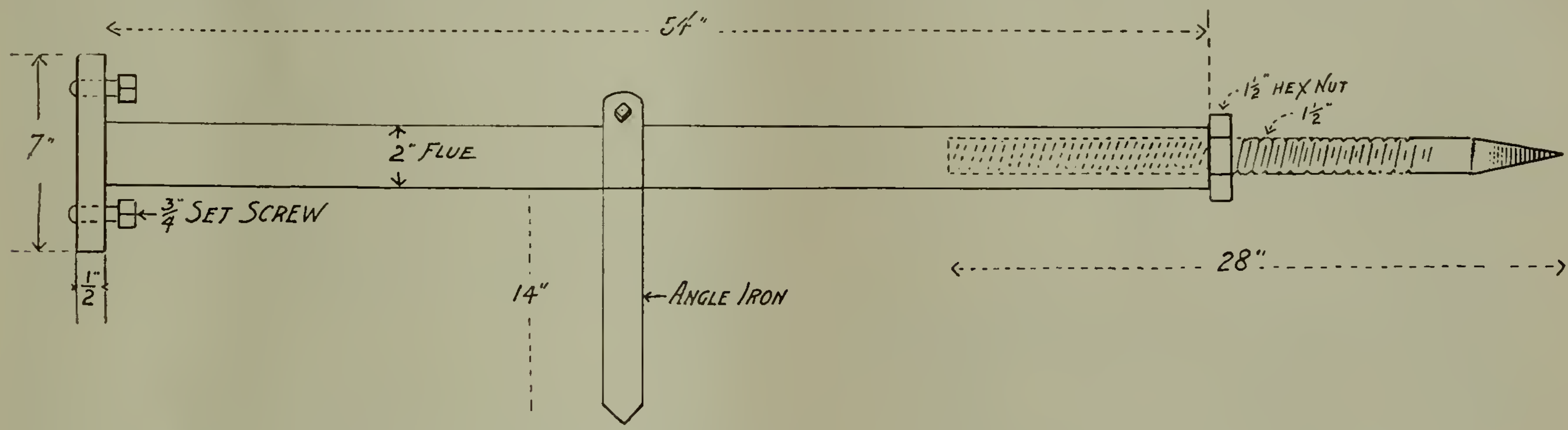
In our dealings with the souls of other men, we are to take care how we check, by severe requirement or narrow caution, efforts which might otherwise lead to a noble issue.—*The Stones of Venice.*

Practical Suggestions from Railway Shop Men

A NEW OLD MAN

By W. E. Johnson, Storekeeper, W. P. Ry.

The drawing I send you is of what is termed by boilermakers "The New Old Man." In the past there has been considerable trouble in drilling out stay bolts in the fireboxes of locomotives, boilermakers have also experienced the same trouble with patch bolts and rivets and also with mud-ring studs. This device has overcome a great deal of this trouble, as in drilling out mud-ring studs it can be used to advantage by placing the flat piece, with the two set screws, in the floor and the point in the mud-ring, but the greatest advantage is in its use in the firebox where a boilermaker is in close quarters.



The "New Old Man" Used on the W. P. Ry.

In making the apparatus use a piece of flue 2 x 54 ins. long and to it, fasten a piece of ½-in. boiler plate 7 ins. long made in an oval shape to suit. In the center drill a 2-in. hole, and expand the roll and beed it over the same as in fastening a flue in a flue sheet. Drill two holes, one in each end of the boiler plate, and tap out for ¾-in. set screws. Next take a piece of 2-in. angle iron 28 ins. long and cut off one half of the rib in the center for a distance sufficient to allow stock enough to go around the flue. Rivet the two backs of the angle iron together and drill a hole ½-in. in one end for a clamp to make solid on the flue. In making the point use a piece of 1½-in. round iron 28 ins. long when finished. This will necessarily not be as long when taken to the blacksmith to shape to a point. When this has been shaped properly, place it in a bolt threader and thread the entire length of the pointed iron. On this place any common 1½-in. hexigon nut which is to be used in adjusting wherever used.

One of these is now in use at this place and has proved a great time saver, and is consequently a money saver. The credit due for this appliance belongs to Mr. J. P. Zywicki, who is a boilermaker at this point, viz., Butler, Wis.

PRACTICAL HINTS FROM SHOP MEN

In our pages there is what amounts to a department, and it is called Practical Hints from Railway Shop Men. This department is most useful, interesting and important, but it cannot be kept up by the staff of the RAILWAY MASTER MECHANIC without direct and efficient help from our readers. The more they help us the better the department becomes.

The department might be called "Wrinkles" or "Kinks" or any name you like, but its character and its object remains the same. It is intended to put before our readers the neat, handy, nifty little devices, or quick methods of doing work which the practical experience of any one engaged in railway work may give to another.

We solicit these practical, useful hints. We will look after style, and the wording of the letter or description you send in. We will reproduce your sketch; pen, pencil or brush; and we will pay for what we use. Do not hesitate to sketch and describe anything in your company's shop that helps work along. It may be old to you but it is not old to those who do not know about it. The only way they can hear of it is by your sending it to us. We will publish it and pay you for your trouble.

If there is no objection we would like to publish the name of the man sending us the practical idea, also the name of the railroad he is on and his title or position. We would like to do this only if there is no objection by the person concerned. If there is any objection, we will respect his wishes without question. Sometimes a man may not wish to go on record in his shop about some device, even though he may know it to be good or think it is. In that case he has only to say, don't publish my name, and we will not publish it. Everyone must decide this for himself, and we will be governed by his decision, but do not, on that account, fail to send us in the good thing, or the practical idea, or the cleverly devised arrangement, or whatever it is. We want it, with or without your name, and we will pay for it, but you must let us know who you are, so that we can pay you.

EMERGENCY NUT FOR TALLOW PIPE

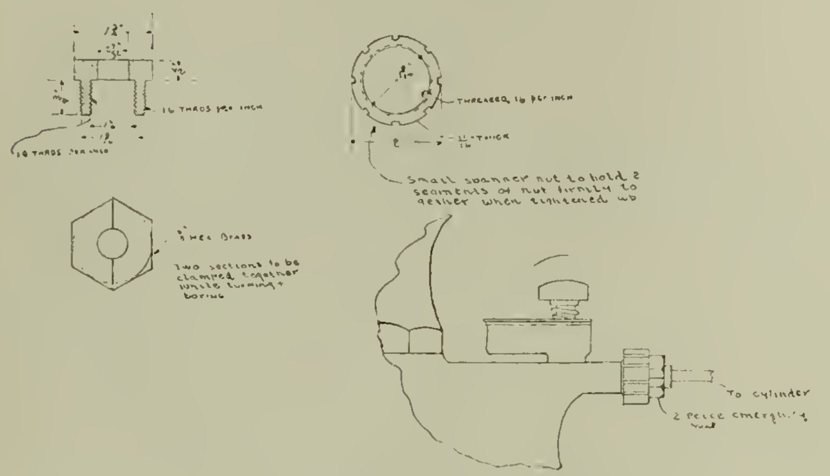
By F. W. Bentley, Jr.

The distance between the lubricator oil pipe connection joint on the body of the lubricator in a locomotive cab, and the point where the concealed oil pipe emerges from the jacket, is not a standard distance. The writer has seen engines of the same class vary from two to three inches in this distance, because of the position of the lubricator and the arrangements made in the cab for accessories.

There are occasions when this condition causes trouble. The nuts to the lubricator joint often strip, or are discovered stripped at a time when the work of applying a new one would cause delay. It is very difficult, sometimes, to temporarily rob another engine of the same class, and the lack of standard frequently finds the pipe too short or too long for the locomotive needing it in a hurry. An oil

pipe too long is often incapable of being bent to allow the necessary drop for the oil into the jacket pipe connection. The accompanying sketch is descriptive of an emergency nut in three pieces, which can be quickly applied and the joint drawn up; the injured nut being allowed to drop or slip down the pipe. This will get an engine out of the house without the trouble of looking for another pipe or the delay of re-brazing the tail piece or collar, to apply to new nut. The emergency nut can be used until the engine reaches her other terminal, where sufficient time can be had for properly applying a new nut.

One of the emergency nuts kept at a convenient place in the roundhouse is a sure safeguard from any difficulties of this kind when the proper method of repair would delay the departure of the locomotive.



Emergency Nut for Tallow Pipe.

The nut itself is in two pieces, and the small spanner nut is the third piece. When a connection nut is found to be defective, and is allowed to slip down on the oil pipe, the spanner nut is placed in position on the projecting end of the lubricator connection. The two-piece nut is then put round the pipe, the spanner nut is shoved over it, where it fits tightly, and the whole thing is tightened up with next to no delay. At the other end of the run when the trip is over, the emergency nut comes off, to be used again when required, and permanent repairs are made.

BETTER LOCKERS FOR WORKMEN

Editor, Railway Master Mechanic.

Sir: I would like to call the attention of our master mechanic and the shop foreman to the size of lockers used here for employes who change their suits of clothes, as most round-house employes do that are on night shift. I would like to do this through your columns.

We come with fairly good clothes, for the reason that it looks and shows up well for the men, and for the good of the company that they work for—that they are a good class of men, and I believe the officers are proud to see their employes look respectable when coming and going from the shops.

So, I ask, why not provide good lockers, of ample size, to hold our clothes? Many times it rains or snows, and damp clothes, if not hung up, will not dry by the time we return to work. Let us have good-sized lockers, so that we can keep our clothes properly. They should be hung up, and not rolled up. A good-sized locker does not cost any more than a smaller one. When I say a good size, I mean 5 ft. high, 3 ft. wide and 1 ft. or 15 in. deep, with a sloping top and a shelf or two.

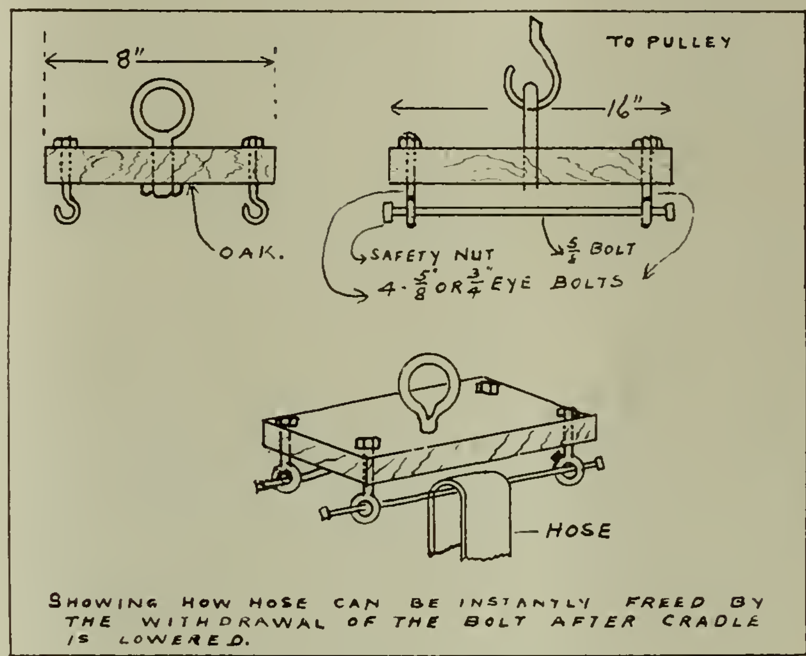
There are many poor lockers, and few good ones. I respectfully call the attention of our master mechanic to this. Please give us the good locker. Worker.

DETAILS OF SMALL SHOP HOSE DRAINER

By F. W. Bentley, Jr.

Last month we were able to give a half-tone illustration of a very satisfactory method of fire hose draining and drying for small railroad shops. The illustration showed a mast or telegraph pole from which was suspended a line of hose fastened to or held up by a cross piece. The hose was raised by pulling up the cross piece.

This month we are able to show some details of the cross piece, which on close inspection turns out to be a saddle fitted with bolts, nuts, swivel, eye-bolt, etc. The saddle is made of wood and it is fitted with an "eye" into which the hook from the pulley is inserted. The four corners of the saddle have each an eye bolt and each pair takes a cross bolt, and over this horizontal cross



Details of Hose Drying Apparatus.

bolt six lengths of hose can be pulled up if necessary. The withdrawing of this cross bolt frees the hose.

When lowered the ends of the hose can be laid out on a reel and wound up. The arrangement is simple, easy to make, it does not cost much and is exceedingly useful. It is handy, insures the proper drying of the hose, and is worth a trial by anyone requiring to handle hose quickly and efficiently.

BOX HEADERS FOR BOLT DIES

By W. E. Schofield, Smith Shop Foreman.

The photographs show headers made as usual, by drilling and slotting the hole to the size of the head it is intended to make, and shaping the plug to fit, which is a tedious and expensive operation. In trying to devise some other way to make them, I may say that our first consideration was not, as many contributors say, "that as so many things seem to have conspired to effect the receipts of the great arteries of trade, that in our humble way we have tried to do our part to lessen the burden." Our aim on the I. C. R. was to devise some plan to make the headers so that we could get them in a reasonable time, regardless of cost. Fortunately the plan has reduced the cost 50 per cent. By this plan we may have infringed on the methods of some of the old practitioners, but if so, we apologize.

In the Burnside Shops of the Illinois Central Railroad we have three different headers, which necessitate three jigs, but all are on the same plan. The

photograph shows also the jig and punch for making, and the forging as it comes from the jig, ready to go to the Machine Shop to be finished, which is a simple operation. It consists in turning in a lathe to fit the hole in the header holder. The jig is simply a cage with a top piece to act as a guide for the punch. The body of punch is round. The diameter is slightly larger than diagonally across the square of the largest square head to be made in each jig.

The end of the punch is shaped to the size of the head it is intended to make, either square or hexagon, with

Jigs for Box Headers for Bolt Dies.

slight taper in order that the punch can be easily removed. The punch is hardened before using. The blank is heated and scale removed and quickly put in cage guide. Cap put on top, punch is oiled, placed in position and struck a quick sharp blow by the steam hammer, which drives it home to the shoulder on the punch. Guide cap is then removed, and the punch quickly taken out, and cooled. Then it is ready for the next blank.

It is our practice to make both headers and punch from scrap locomotive driving tires, which will harden and make a very serviceable header at small cost. The reason we use scrap tire is that we can always get it in any quantity required. We have made with the same punch many headers, without it showing any defect, and if used carefully it will last a long time. We believe anyone who uses box headers and will make and try this jig once, and compare it with old way, will be convinced of its merits.

MARBERRY LOCOMOTIVE COAL SHIFTER

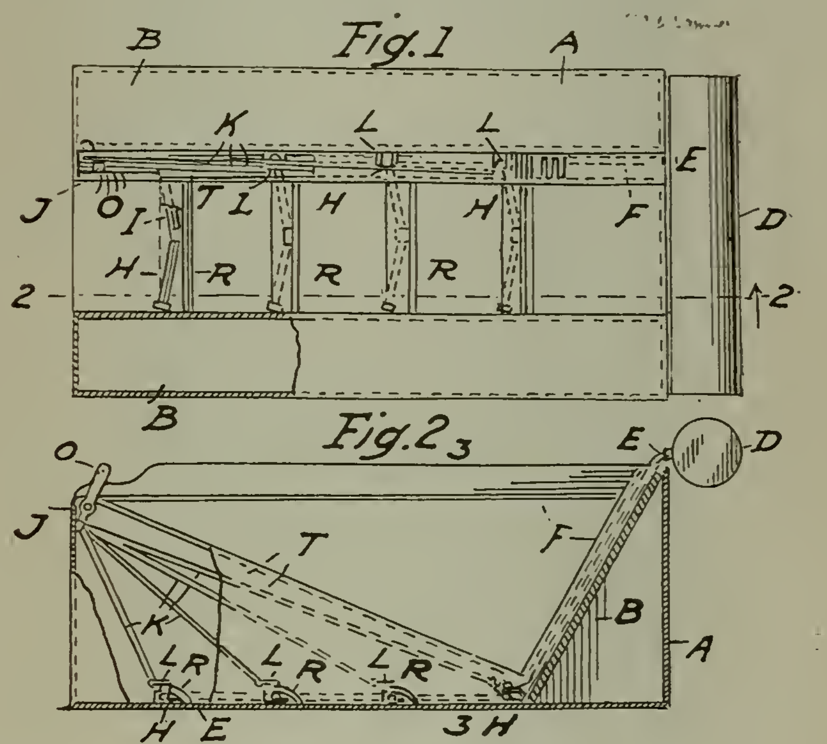
By E. W. Welch, Office of Mast. Mech., St. L. & S. F.

A device has recently been patented by W. L. Marberry, an engineer of the St. L. & S. F. Railroad, which, it is expected, will be useful to railroads which are equipping their engines with automatic stokers, as by the use of the device the coal in the back of the tender can be moved directly into the hopper of the stoker. On an engine which is not equipped with a stoker, the coal can be moved to the front of the tender, or to any other part of the tender which is desired.

The device is operated by either compressed air or steam, which is contained in reservoir D, shown in fig. 2 on the accompanying drawings. The air or steam is conveyed from this reservoir down the back and along the bottom and side of the tender to the front through pipe E. The pipes H lead from pipe E across the bottom of the tender at a distance of about 3 or 4 ft. apart. In pipes H are small openings I, each with a projecting nozzle, from which the air or steam issues with sufficient force to blow the coal forward from the bottom of the tender.

This jet of air or steam undermines the coal, causing the top of the pile to fall to the bottom of the tender, and in turn be moved to the front. The branch pipes H are protected from coal falling on them by shields R, which extend from the bottom of the tank on an incline. The feed pipe E is also protected by housing F, which runs parallel to the side of the coal space to prevent coal from falling on it. At the junction of pipes E and H there is a valve for the purpose of turning on or off the air or steam, the valve being operated from front of tank by rods K and links L, which are connected to lever O in such a manner that air or steam may be turned into any one of pipes H or all of them at the same time if desired.

Pipes H are arranged with nozzles of openings I at an angle: the first one from the front at an angle of



Coal Shifter for Locomotives.

about 45 degs., the next one slightly less and so on. Thus it distributes the coal more evenly. It will be seen that pipes H may be arranged in such a manner that coal will be moved to any desired part of the tender by merely changing their location. The cost of installing this device is comparatively small, not more than $50 at the most.

The Railway Library and Statistics for 1914, compiled and edited by Slason Thompson, published by Stromberg, Allen & Co., Chicago. Sold by Bureau of Railway News and Statistics. Single copies, $1.

This is the sixth annual issue of the "Railway Library," and includes within its covers noteworthy addresses and papers delivered during the year 1914 relating to railway subjects.

When such well-known men as James J. Hill, President Ripley, of the Santa Fe; President Rea, of the Pennsylvania, and other noted leaders in practical railway affairs, are represented by articles in it on railway problems, it makes the book more than interesting. Various subjects, such as railway valuation and taxation, parcel post burdens, and cutting down express returns are treated forcefully and well. Foreign railways also have space devoted to them. It is a most excellent work to have close at hand at all times.

Personal Items for Railroad Men

Sir William C. Van Horne.—In this issue of the Master Mechanic appears an editorial on the Human Element, which, as we have undertaken to show, is of so much consequence in railroad operations. No better example of this element ever lived than Sir William Van Horne. He stands prominently forward as an instance of a man who started at the very bottom and because he was made up of the right material, reached the topmost round of the ladder and died famous. His successes were legion and his popularity was founded upon the golden rule that "he did unto others as he would they should do unto him." His 73 years of life were rounded

William Cornelius Van Horne.

out into an immeasurable compass. From a railroad office boy at 14, he moved into one position after another and was advanced on his merits, until he became a general superintendent; a general manager; and president and finally chairman of the board. These latter positions with the Canadian Pacific. From 1881 down to his death, which occurred on September 11 of this year at Montreal, he was closely and especially identified with this great Canadian railway. He was at the same time interested in many other corporations. Sir William received his title in 1904. He was a member of many clubs and many societies; was one of the great art collectors on this side of the Atlantic; and was an artist as well. He was known as the "Hill & Harriman" of Canada, and was instrumental in making the Canadian Pacific one of the greatest railways in the world. He died covered with honor and was universally respected. William Cornelius Van Horne was a great man.

Mr. Edward M. Grove, Treasurer of the McConway & Torley Co., of Pittsburgh, Pa., died on Thursday, August 26, 1915. Mr. Grove was born in Chambersburg, Pa., October 12, 1857. He went to Philadelphia when 14 years of age and worked for a time in a printing office. In 1876 he became a telegraph operator at Merian, Pa., a suburb of Philadelphia. After about 3 years' service as operator at this point he became District Superintendent of the Pullman Company at Cincinnati, Ohio, and was from there transferred to Jersey City, N. J., in a similar capacity for the same company. In 1886 he accepted a position as Assistant General Manager of the Wagner Palace Car Company in New York. He left this position to come to Pittsburgh with the McConway & Torley Co., with whom he has been associated for 26 years, the last 15 years of which he has been Treasurer of the company.

Mr. Grove has been prominently connected with the Railway Supply Manufacturers' Association, of which he was President in the years 1910-1911. Mr. Grove had an extensive acquaintance among railway officials and railway supply men, by whom he was highly esteemed for his sterling qualities of heart and mind.

Mr. E. S. Farley has recently been appointed Acting Superintendent of the Sante Fe, with headquarters at Amarillo, Tex.

R. M. Boldridge, recently appointed Master Mechanic of the Apalachicola Northern R. R. at Port St. Joe, Fla., succeeds J. P. Dolan, resigned.

Mr. A. J. Devlin has recently been appointed traveling round-house foreman for the St. Louis and San Francisco R. R., with headquarters at Springfield, Mo.

Mr. A. G. Kentmann, recently appointed Master Mechanic of the N. O. & N. E. and A. N. V., Rys., with headquarters at Meridian, Miss., succeeds Mr. Phillips, deceased.

Mr. A. P. Jander, recently appointed General Foreman for the A. T. & S. F. R. R. at Trinidad, Col., was formerly Erecting Foreman for the Sante Fe at Raton, N. Mex. At Trinidad he succeeds Mr. P. B. Coffelt, deceased.

W. H. P. Fisher has been appointed Sales Manager of the L. M. Booth Company, of New York, manufacturers of Booth Water Softeners. He will make his headquarters at the Engineering Department, Jersey City, N. J.

G. H. Walder, recently appointed Engineer of Tests of the Chicago, Milwaukee & St. Paul Railway, entered the Engineering Department of that road in 1912 and now succeeds W. F. Lynaugh, resigned, to accept a position with the government in connection with railroad valuation.

Mr. F. C. Kyle, recently appointed Master Mechanic of the K. C. M. & O. Ry., entered the employ of that road in 1910 as division foreman at Altus, Okla. In 1914 he was made General Foreman of the Wichita shops, Wichita, Kansas, and now succeeds Mr. W. D. Bennett, resigned.

Mr. M. F. Mawhinney, acting Master Mechanic of the Kanawha & W. Va. R. R. of Charleston, W. Va., succeeds Mr. J. W. Mahan, resigned to go into other business. Mr. Mawhinney entered railroad service as a machinist 26 years ago. In 1908 he was appointed round house foreman at Cane Fork, W. Va., on a branch of the C. & O. R. R., and in 1912 made connections with the Kanawha & W. Va.

Mr. H. R. Kindall, recently appointed General Foreman of the C. N. O. & T. P., was, in 1907, appointed General Foreman of the Wabash R. R. at Moberly, Mo. In 1909 he became Machine Foreman for the Ill. Central at Memphis, Tenn., and in 1914 entered the employ of the C. N. O. & T. P. as machinist at their Ferguson

shops. Two months later he was made night foreman at Danville, and has now been made General Foreman at Oakdale, Tenn.

Mr. W. C. Myers, recently appointed General Superintendent of the St. Louis and Belleville Electric Company at East St. Louis, Ill., entered the service of the New York Central R. R. as locomotive fireman in 1900. In 1903 he became Traveling Fireman and in 1905 Locomotive Engineer for that road. In 1908 he entered the employ of the General Electric Co., and in 1911 became Assistant Electrical Engineer for the Southern Pacific R. R., where he remained until the appointment mentioned above.

Mr. E. J. Williams, recently appointed Master Mechanic of the N. O. G. N. R. R., entered railroad service as manchinist apprentice in the Illinois Central shops at McComb City, Miss., in 1893. In 1910 he entered the service of the N. O. G. N. R. R. at Bogalusa, La., and in 1912 was appointed Roundhouse Foreman. May 15, 1915, he was appointed Acting Master Mechanic to succeed Mr. Jungling, who accepted the position of Superintendent of Motive Power on the T. & N. C. R. R. at Cresmont, N. C. His appointment as Master Mechanic has recently been announced.

Mr. B. C. Tracey, recently appointed supervisor of electric welding on the Baltimore and Ohio railroad, with jurisdiction over this work in all shops on the system, is believed to be one of the youngest men ever appointed to an official position on an American railroad. Mr. Tracey is a youth in his early twenties whose railroad career is an example of the training which the B. & O gave the young man to fit him for his life's work. Entering the service as a messenger boy, he was taught elementary studies in a night school supported by officials of the B & O and other business men of Baltimore. Later he was entered in the railroad's course for shop apprentices and given an opportunity to specialize in electric welding.

Mr. C. W. Reed, recently appointed road foreman of equipment on the Nebraska Division of the C. R. I. & P. Ry., entered the service of the Rock Island as fireman on the East Iowa Division in 1897, and was promoted to engineer in 1901. In 1912 he became Assistant Road Foreman of Equipment of the East Iowa Divsion, returning shortly to the position of Engineer on account of reduction in force. A few months later he became Assistant Train Master, and early in 1914 was again returned to the position of engineer on account of reductions in force. Shortly after Mr. Reed was made Road Foreman of Equipment of the Missouri Division and has now been transferred to the Nebraska Division, succeeding Mr. D. W. Higgins.

R. A. Lunsford, recently appointed Storekeeper of the Kansas City, Mexico & Orient Railway at San Angelo, Tex., entered the service of the St. L. & S. F. R. R. in 1901 in the Transportation Department. In 1907 he became General Superintendent, in charge of the Mechanical Department of the Kansas City & Memphis Railway, and in 1909 was appointed Chief Clerk in the Mechanical Department of the Kansas City, Mexico & Orient Railway. In 1913 Mr. Lunsford was appointed General Foreman in charge of the Locomotive and Car Department, with headquarters at Fort Stockton, and in 1914 was transferred to Hamlin, Tex., where he remained until he succeeded as Storekeeper, T. A. Pratt, who has left the service of the K. C., M. & O.

Mr. G. B. Obey, Superintendent of the Monongahela Railroad, has been appointed General Superintendent of the Monongahela Railway which was formed recently by the consolidation of the Monongahela Railroad and the Buckhannon & Northern. Mr. Obey entered the service of the Pittsburgh & Lake Erie as a train dispatcher in 1889 and in 1899 was promoted to chief train dispatcher. Two years later he was appointed Superintendent of the Youghiogheny and Mononghela Divisions of the same road, with headquarters at Pittsburgh, Pa. In 1905 he left the service of the Pittsburgh & Lake Erie to become Superintendent of the Monongahela Railroad, with office at Brownsville, Pa., which position he held at the time of his recent appointment as General Superintendent of the Monongahela Railway, with headquarters at Brownsville, as above noted.

Mr. Riley E. Phillips recently celebrated fifty years' continuous service on the New York, New Haven and Hartford Railroad. As the ranking engineer and one of the most popular men in the service, Mr. Phillips received congratulatory messages from officers and fellow employees of the Company. His case forms an instance of a first-class quality of human element, a subject to which we have devoted some space elsewhere in this issue.

Economy, efficiency and safety are all embodied in a character of this kind.

Mr. Phillips was in his earlier days a printer in the printing house of Thomas Stafford. He remained there

Riley E. Phillips.

until the outbreak of the Civil War. He served in the 15th Connecticut Volunteers.

Six days after receiving an honorable discharge from the army in 1865, Mr. Phillips entered the employ of the New York and New Haven Road on July 18th, 1865, as a fireman. At that time the road operated seventy-three miles of track and owned thirty-one engines. In 1868 he became an engineer, but did not receive his papers as an engineer until August 16, 1870. Since that time he has run every type of engine in the Company's service and has handled some of the fastest express trains on the line. At present he takes the Bankers' Express from New Haven to New York.

During his years of railroad life Mr. Phillips has had one or two narrow escapes. On one occasion the depot

platform at Pelhamville, N. Y., was lifted by a hurricane and thrown across the tracks, derailing the "Owl" train, and throwing the engine down a 95-foot embankment. The fireman was killed, but Mr. Phillips escaped with slight injuries.

Mr. Phillips is married and lives in New Haven. He has three children living of whom one is Claims Attorney for the Comany for the State of Connecticut, with offices at New Haven, another son is in Bowdoin College, and his daughter is married to F. F. Bergin, lawyer, and lives in New Haven.

When Mr. Phillips first ran trains into New York City cattle were pastured in the fields around 100th St.

Despite his active years, he ranks with the best in the service and looks as hale and hearty as younger men.

BOOK REVIEWS.

"Biographical Directory of the Railway Officials of America," published by Simmons-Boardman Publishing Co.

This 1913 edition, so-called, is the seventh in the series pubished, beginning with 1885. Since the latter date there have appeared editions in 1887, 1893, 1896 and 1906, respectively. The purpose of this directory is to give a concise and accurate record, without embellishment of the railway service of general, divisional and departmental officers; and the seven closely packed volumes constitute an interesting history of change in railway personnel, including promotions, transfers and retirements.

The first issue made up a volume of 276 pages and contained 3,764 names. The 1913 edition comprises 625 pages and contains 4,200 personal histories. In 1885 the railway mileage of the country was but 128,000. Today it is over 245,000. There were 600,000 railway officers and employees in America in 1885, while today this army of faithful workers in the railway field has in its ranks 1,700,000; equal to the standing armies of France and Germany in time of peace. The 1913 edition before us is as complete and full as it can be made and is a book which should be in the hands of every one who is interested in railway affairs. As a book of reference it is invaluable. The price is $4.00, net, and is sold by the McGraw-Hill Book Co., Inc., at 239 West 39th St., New York.

Locomotive Engine Running and Management, by Dr. Angus Sinclair, twenty-third edition, is just off the press. This book has been in use since 1885, the year of its original publication, and in the thirty years it has run its course it has had an average of 1.3 editions a year. As a matter of fact, no such set figure marked its progress, but in stating it this way the language of the mechanic arts is adhered to, and that is understood by all. The book retails for $2.00.

The story is told that in order to have the book practical and easily understood Dr. Sinclair, then an engineman, read the book chapter by chapter as it was written to his fireman, and if that worthy understood it readily the chapter stood. If the fireman remained in ignorance, the chapter was revised or re-written.

There is no change in the principles involved in the science of railroading, and in many ways this edition is similar to those that have gone before. In this respect the book makes no pretense to any radical advance. There are, however, several new features in the 23rd edition which give it an important place in railroad literature. The book contains several features of real value. The chapter "Modern Air-Brake Equipments," and the questions and answers on this subject, is the latest thing on air brakes that has appeared in book form at the present time. The chapter on the "Mallet Compound" is also up to date, and the chapter on "Radial Valve Gears" is also exceedingly useful and instructive. Chapter XXI gives the first year's examination for Firemen and Enginemen on general locomotive subjects and air brakes. The second year's papers cover general and air-brake questions, and follow with similar questions and answers for the third year's examination.

The chapter on the Mallet Locomotive is in question and answer form, and the book closes with a chapter on the Operation of Superheater Locomotives. There are in all 23 chapters, and the book is composed of 428 pages of text and is followed by an index. The book is about 7½ x 5 ins. and contains many things which must be known and understood by any man who may desire success as a locomotive runner. Speaking of the uninstructed fireman of long ago, Hill said he "learned a lot of things about a locomotive that aren't so." There is now no need to learn anything not useful and true, nowadays, we say. This book is one of the helps.

Official Proceedings of the Ninth Annual Convention, Master Boiler Makers' Association, 1915. Price $1.00 per copy.

We are just in receipt of the printed report of the meeting of this association, held in Chicago, May 25, 26, 27 and 28, 1915. It is in book form, very neatly gotten up and substantially bound and covers the entire proceedings in detail. The addresses and reports presented by various members and committees are both excellent and timely and include subjects of special interest to those who have to do with the construction and maintenance of locomotives.

This well known association has some 400 members, so that practically every road in the country is represented in the organization. The tendency of all the railroad associations nowadays is toward a standardization of methods, and excellent work is done at their annual conventions. This report has such merit that it should be in the hands of every railroad man who is interested in motive power. Others can look it over and be well instructed. It should command a prominent place on the shelves of every railroad library.

Proceedings of the Seventh Annual Convention of the International Railway Fuel Association, held in Chicago May 17 to 20, 1915. Price $1 each for red morocco leather binding, gilt edges, and 50 cents each for paper binding, plain edge, carriage prepaid. C. G. Hall, Secretary and Treasurer, C. & E. I. R. R., McCormick Building, Chicago.

This is a most excellent presentation of these proceedings, both in the matter included as well as in the style of binding. It treats almost exhaustively of every subject relating to locomotive fuel.

SMOKE ABATEMENT WORK

Smoke inspectors of cities that are now enforcing smoke ordinances, representatives of cities considering laws for regulating the emission of smoke, delegates of civic leagues and chambers of commerce from communities where the subject of smoke abatement is a live issue, also railroad representatives who have done much to uphold the standard of smoke abatement, recently attended the tenth annual convention of the association in Cincinnati.

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ANNOUNCEMENT

Joseph A. Kucera has joined the staff of this publication as business manager. Mr. Kucera entered the publishing business nine years ago with the Wilson Company, Chicago, where he was business manager of *The Railway Age* and *Electric Railway Review*. On the sale of those properties in 1908, Mr. Kucera went to the McGraw Publishing Co., which purchased the *Electric Railway Review* and consolidated it with the *Street Railway Journal*. Since then Mr. Kucera has served as business manager of the *Electric Railway Journal*, of the *Electric World*, and later of both publications.

Mr. Kucera's previous experience covers several years with freight and law departments of western roads, and for three years he was in the employ of the attorneys of the People's Gas Light & Coke Co. He has a degree of LL.B. and was admitted to practice law in Illinois.

MACHINE TOOLS AND SOUTH AMERICA

A good deal has been said and written about the necessity of our capturing the South American trade, and the present time seems to be propitious. We have, however, had an object lesson of recent date, set forth in one of the Commerce Reports, which shows very plainly the activity of our rivals. America can turn out an excellent line of machine tools for railway repair work and for other purposes, yet we do not seem to have made much headway in placing our wares in the market which, by geographical position, is legitimately ours.

In Buenos Aires, for example, there is an industrial school. It is a technical institution, for the purpose of giving theoretical and practical instruction to the young men of the Argentine Confederation. Buenos Aires is the first city of South America in size, and has perhaps the largest share of the export trade of the country. It is a railway terminus and has many manufactures.

The studies in the industrial school occupy six years, two of which are devoted to practical training in the various shops of the school. To provide for this, the report says, "there has been established a foundry, a machine shop, a carpenter shop, an electrical workroom, a laboratory, and a special railroad material showroom equipped with working models and sections of every description. Besides these there is a separate museum of working models in mechanical, electrical and other lines, with exhibits of pumps, engines and almost every other class of appliance."

This is all very well, but most of the machine tools and nearly all the working models are of European make, those of Germany predominating. Very few are from the United States. The explanation of this lies in the fact that the equipment of the school was practically a gift from foreign manufacturers and did not cost the recipients anything at all. Just before the war broke out a group of German manufacturers offered this school a complete outfit of modern tools for the shops on the express condition that the school authorities were to remove all tools not of German make.

This is not mere underselling in an open market. This plan, if carried out, would place before upward of 500 students each year nothing but one country's products, and it would compel them insensibly to imbibe a preference for what they first began to study and for that with which they later became familiar. The shops and exhibits are viewed each year by thousands of visitors, many of them manufacturers, and the advertising value of the constantly recurring suggestion is a silent but potent ally of the foreign tool-makers. American products are not kept out by prejudice and are not excluded by any narrow preference. American firms have simply not made the same effort as the foreigner has to gain first place. America is beaten by default.

At the present time, when the sea-borne commerce of a trade rival has been completely stopped, our own machine-tool and other manufacturers should band together in some form to advance the campaign for South Ameri-

can trade to a more aggressive stage. The machine-tool men of this country have no need to be ashamed of the product of their factories; their work is excellent and their machines are designed with a clear perception of the work they have to do and the way to do it quickly and cheaply. But the machines are not known as they should be in the southern half of this continent.

The industrial school at Buenos Aires uses a 220-volt continuous current for models of machinery when shown in operation, and these motors, with diagrams showing internal or hidden construction of the machines, should be supplied by those adopting this method of reaching the South American buyer or operator. Lists of the various classes of machinery, tools and materials now owned by the school, and of those which it still requires, may be learned on an application directed to the Bureau of Foreign and Domestic Commerce, File 750, at Washington, D. C.

RENEWAL FUNDS

During the past several years, especially, all the railroads in the country have had to be operated, as the expression goes, "for all they were worth." Expenditures pared down, almost dangerously, because of necessity, have left barely enough beyond the immediate operating requirements to meet interest charges and other determined obligations. There would, therefore, have been no funds to apply toward a renewal account, if one had ever been established. An account of this nature, though, marks a desire to be thrifty. As a rule, when equipment is needed for replacement, or the time comes for a new bridge somewhere on the line, or there is an urgent demand for an especial lot of new rails—all properly belonging to the operating account—the money to meet these outlays is either raised by a sale of securities or a loan at the bankers, which must be paid eventually with interest.

The thrifty business man provides for his wants in advance. He arranges for a season of need by withdrawing sums, on occasion, from his income, when times are good, which by and by amount to a substantial fund. With this in bank he is in position to put an addition on his house, buy an automobile perhaps, or indulge in some other long desired improvement, without running into debt for it. If his business calls for increased facilities, he has the money to provide them, without calling on his banker or loading his factory with an ever menacing mortgage.

The railroad company, therefore, which adopts a similar policy has started on a line of thrift which, after a term of years, produces marvelous results and there will be no evidence of this extreme care in badly maintained tracks or shabby equipment. Daily needs are taken care of in the usual way, of course. A fund, in addition, based upon mileage performed by engines and cars and upon a reasonable percentage for depreciation in other directions, deducted from the current earnings each month, laid by in cash, and charged to the proper operating accounts, increases gradually and aids, in a substantial way, toward general maintenance, when required.

It cannot be expected that such a fund will take care of all unusual operating needs, but it will be large enough to make good for cars that may be destroyed by accident or otherwise or to replace a locomotive or a bridge which has been unexpectedly wiped out, or provide new rails here and there beyond the ordinary annual requirement. Every $10,000 saved in this way means not only better maintenance, but represents the interest on $200,000 of bonds and no one knows better than the financial head of a railroad how promptly interest day arrives and how ready the bondholder is to collect his dues. Even the small road may find the renewal fund plan one of the best safety measures it could adopt.

The very fact that a "renewal account" is in vogue encourages more carefulness, generally, and puts the railroad on a par with the well conducted business enterprise. Now that good times are approaching it would be a mark of wisdom to provide a fund of this sort which will help toward keeping the property up, without embarrassment, later on.

In a coming issue this subject will be more fully discussed and more details presented concerning the plan upon which a "renewal account" may be opened and successfully carried out.

GOVERNMENT RAILROAD MANAGEMENT

The National Transcontinental System of Canada was planned in 1903, under an arrangement whereby the Grand Trunk Pacific was to build the line from Winnipeg west to Prince Rupert and the government was to construct the line from Moncton to Winnipeg. The latter section, known as the Eastern Division, when completed according to government specifications was to be leased to the Grand Trunk Pacific for fifty years; that company furnishing the necessary equipment and paying as rental, after the first seven years, 3 per cent. per annum on the cost of construction, besides operating expenses and maintenance.

Under the supervision of four government commissioners, work of construction was begun in 1904, based upon what was termed a "liberal" estimate of all expenditures. That estimate called for $35,000 per mile from Winnipeg to Quebec, or $47,040,000, and for $31,250 per mile from Quebec to Moncton, or $14,375,000, making a grand total of $61,415,000. Seven years after the construction had actually begun, there had been expended $109,000,000 and the engineer in charge then reported that $161,300,000 would have to be spent, in all, to complete the work, exclusive of interest. By the end of 1914 there had been put into this transcontinental pathway, all told, $173,000,000 without interest charges and the undertaking was still unfinished. There had been an underestimate of $110,000,000 already, but sums like this are but trifles to a healthy first class government.

When the present conservatives came into power in 1912 an investigation was started under the supervision

of a thoroughly practical railroad man which unearthed methods in vogue that startled the whole Dominion. Forty million dollars were found to have been wasted. Contracts for work had not gone to the lowest bidders; some contractors had been overpaid more than $3,000,000 and all sorts of expensive and unnecessary construction had been adopted.

It is not surprising, then, that the Grand Trunk when called upon to assume this gigantic burden refused compliance. It insisted upon an elimination, in some way, of the $40,000,000 charge which had gone to waste. This refusal forced the government to get into the railroad business, and on May 1 last, the equipment having been supplied by the Dominion, the operation of the line was begun, under the Government Railways Managing Board, with what results no one has yet been able to conjecture.

This is an instance of what a government can do when it sets out to build a railroad and it is only fair to assume that as it constructs so must it operate.

A glance at the status of the Intercolonial of Canada, also under government control, throws some light on such operations. This road has a capitalization of $65,000 per mile while the net capital of independently owned railways in the Dominion is less than $51,000 per mile. In the year 1913 the earnings were $161,000 less than the operating expenses.

What might have been the result under the supervision of an unhampered first class practical railroad man is a question for the taxpayers of Canada to consider, even though they may never see an arrangement of that kind put in vogue. The trite saying that "the shoemaker should stick to his last" applies as well to governments as to individuals, and the wise man who declared, "We little know with what poor judgment we are governed," laid down a sentiment which is worthy of our best consideration at all times.

FACTORS IN ELECTRIFICATION

With the Norfolk & Western and the Pennsylvania just completing extensive electrification projects, and in view of the activity forecast in other directions, it is not untimely to inquire into the present status of steam railway electrification in the United States. It is evident that the last five or six years have seen experiments carried out on a large enough scale to give practical data that will be of permanent value.

When we consider that the growth of the steam locomotive has paralleled the increase of traffic demands for years, while the electric locomotive was worked out on a draughting board, it is not hard to appreciate the value to electification of a few quiet years in which to accomplish reliability. The same progress can be recognized in methods of power supply. The third rail and the catenary trolley suspension have been carried to such a point that on the Pennsylvania recently a two-hundred-mile section of four tracks was electrified without interruption of steam traffic. Another advance which the past few years has proved correct is the use of high-voltage alternating current for trunk-line service, first tried on the New Haven and carried to its present success by W. S. Murray, their consulting engineer.

These things are done. From the standpoints of construction, operation and maintenance electrification is a proved success. The question now is rather, what conditions warrant electrification? Historically, it was the terminal that first received attention. Here the elimination of smoke and noise was demanded by the public, and as terminal property increased in value, electrification of terminals has made possible their being carried underground, releasing large areas of income producing property that otherwise would be a lasting expense. However, on trunk or main line electrification, it is necessary to show that the saving in dollars effected by the electrification is greater than the interest and depreciation on the cost of the installation.

And this ratio, while it must of course be governed by local conditions, can be simply stated. Every electric locomotive is able to handle enough more traffic than a steam locomotive, and at a sufficiently reduced cost, to save the railroad a definite sum of money each year. Electrification of a given length of track will cost another definite sum on which the interest and depreciation amount to a certain annual expense. If traffic is sufficient over this track to make the total of the savings effected by the locomotives equal or exceed the annual expense of interest and depreciation, the electrification becomes remunerative and economically desirable.

THREE BILLION BUSHELS.

The average person who reads some important announcement which only deals in generalities does not appreciate its meaning, oftentimes, until something in the way of statistics appears to explain it. We read of a three billion bushel corn crop; but who, as a rule, can grasp the magnitude of such a quantity until he is shown with some detail what three billion of bushels really amounts to? If the whole mass of this most important cereal was all shipped to market—a very large portion of it is not, as a matter of fact—it would require for this service 3,000,000 freight cars of 60,000 lbs. capacity each, assuming that they were to be made up into one train. Run over the scales this corn would weigh ninety million tons. Freight car equipment would run very short, for it would require, in round figures, 1,000,000 more cars than are now in service in the whole country. The train, if the equipment could be secured, would be 22,727 miles long, almost long enough to stretch around the Earth, at the Equator. Going at the rate of 25 miles per hour, the usual speed of a freight train, it would require 42 days of 24 hours each to pass a given point. Intersecting traffic would enjoy a long, dreary wait. Should these cars be made up into trains of 40 cars each, about the customary number of loaded cars to a train, they would make 75,000 trains and require 75,000 heavy engines to haul them—or say, 10,000 more engines than could be found in the United States. Should these trains be despatched at 25 miles per hour on a 10 minute headway, it would take 750,000 minutes for them to pass a given point, or 521 days of 24 hours each, or to be more exact, one and one-half years. An average freight revenue of $25 per car per movement would yield $15,000,000, and at the going price of corn today this enormous mass of corn is worth about two billion dollars. This is certainly some corn.

Electrification on the Norfolk & Western

By Reginald Gordon

Electric traction on trunk line railroads has been usually applied to facilitate the movement of passenger trains, but a portion of the Norfolk & Western, in the mountains of West Virginia, has just been equipped for electric operation of freight and coal trains. The Westinghouse Electric and Manufacturing Company and the Baldwin Locomotive Works have jointly provided the equipment, which is now in successful operation on a thirty-mile stretch between Bluefields and Vivian. The line is very crooked and in addition to grades of 1.5 and 2 per cent. there is a single track tunnel 3,000 ft. long on one of the steepest slopes, which introduces great difficulties in ventilation when steam locomotives are used. This step was taken by the road to save time on the division, trains moving at a higher average speed, and to cut down operating costs by a reduction in the number of engine crews, as well as securing lower maintenance costs of the electric as compared with steam locomotives.

Coal trains weighing 3,250 tons have been pulled regularly over this division by two steam locomotives of the Mallet type, except on the 1.5 and 2 per cent. grades, where a third engine was used as a pusher. Owing to the enormous strains on the draft rigging it has been usual to put one locomotive at the head of the train, one in the middle, and the pusher at the rear. On the steep grades these locomotives were able to move trains of this tonnage at an average speed between 7 and 8 m. p. h.

Twelve electric locomotives have recently been put in service as substitutes for the steam locomotives, and are hauling trains in a very satisfactory manner. These locomotives are here illustrated, and it will be observed that they consist of two units, each unit being of the 2-4-4-2 type. Flexibility in traversing curves is secured by the wheel arrangement of the two, half-units that comprise the complete locomotive. Each half-unit is carried on two trucks and each truck has a two-wheel pivoted truck at one end. The two trucks are hinged together in a manner similar to the flexible connection between the front and rear engines of the Mallet locomotive. There are four induction motors on each half-unit, each truck carrying two motors. A pinion on the armature shaft of each motor meshes with a large gear on an auxiliary shaft on each end of which is a crank operating the two pairs of driving wheels by means of side rods. The weight of the complete locomotive is 270 tons, and it is able to exert a tractive force during acceleration as great as 133,000 lbs.

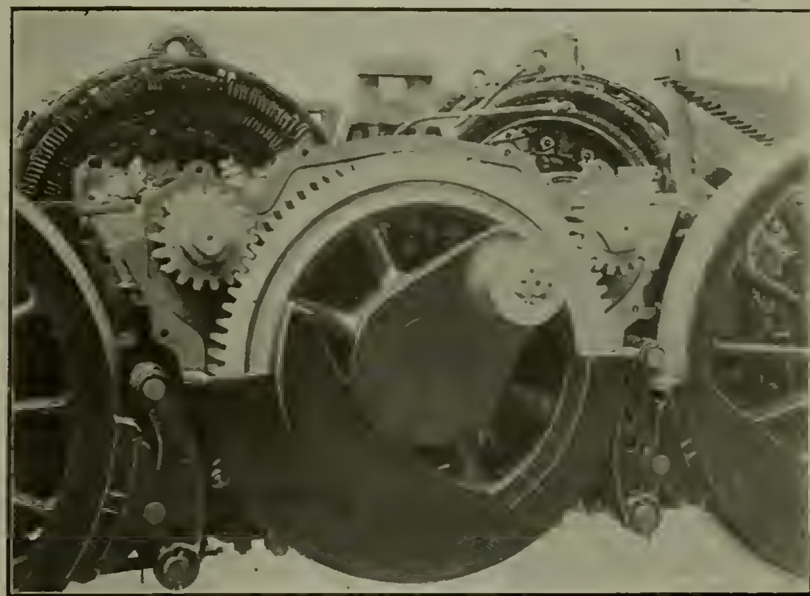
Two electric locomotives or units on the Norfolk & Western, used as one powerful Machine.

Locomotives on the various railroads which use electric power, operate either by direct, or by single-phase alternating current; with the exception of those of the Great Northern, whose line through the Cascade Tunnel is operated by three-phase alternating current motors. The unusual feature about the Norfolk & Western electric system is that while single-phase, 25 cycle alternating current is supplied from the overhead conductor, a converting machine carried on the locomotive itself changes the current into three-phase alternating current for operating the induction motors that turn the driving wheels. Without going into a technical discussion of this question, it will suffice to say that the three-phase induction motor is much better adapted to the requirements of this particular kind of railway service than is the single-phase alternating current series motor. The method adopted for changing single-phase into three-phase alternating current employs a motor on the locomotive called a phase converter which receives energy of the single phase kind and delivers three-phase energy to the main motors that turn the driving wheels. Each one of the four motors on each half-unit has a continuous rating of 325 hore-power, or 410 horse-power for one hour, thus giving a total one hour capacity to the locomotive of 3,280 horse-power. The Mallet locomotives that were replaced by these new electric engines were fully representative of their class and are equipped with superheaters and mechanical stokers.

The power house is at Bluestone, W. Va. It is a steam-driven station containing three 10,000 K. W. turbo-generators. The overhead conductor is supplied with single-phase alternating current at 11,000 volts. Energy is delivered by the generators to the switchboard in the power house at 11,000 volts, and thence goes through transformers which step up this pressure to 44,000 volts, at which pressure it is transmitted to several substations containing transformers which step down the 44,000 volt power to 11,000 volts, and as mentioned, feed it into the overhead conductor from which the locomotives draw their power.

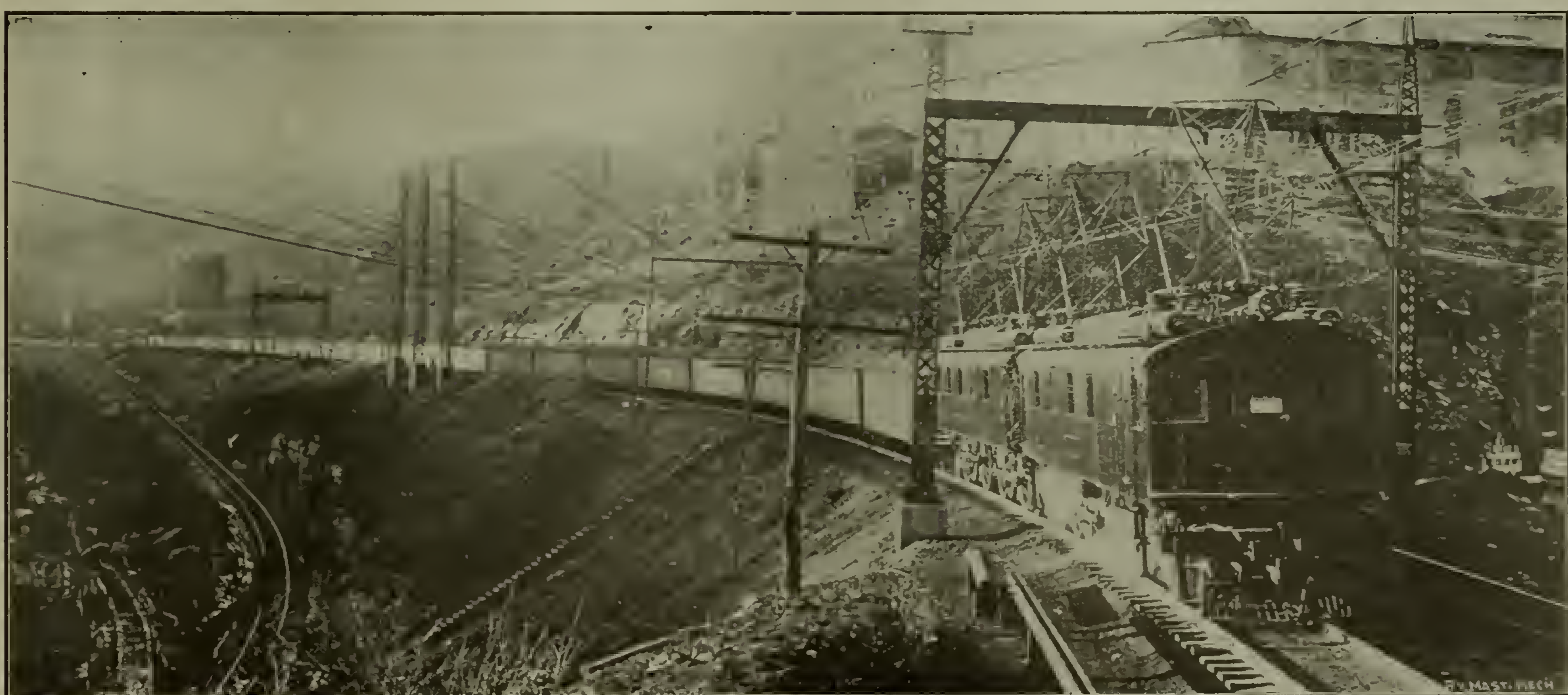
One particular characteristic of the electric motors that drive these locomotives is that they exert their power at certain fixed characteristic speeds; thus, with the regular tonnage trains they are able to maintain a speed of 14 m. p. h. on the 2 per cent. grades; and on level stretches their characteristic speed with the same load is 28 m. p. h. Two of these electric locomotives are now used in place of the three steam locomotives that were formerly necessary to get trains over the road; and in addition to the saving in wages of train crews, there is the advantage of saving in time, since the electric engine is not obliged to stop for coal nor water and it gets over the road faster than the steam engine which it supersedes. This means that in times of heavy traffic trains can be run on shorter headway, and the same locomotive will give more mileage in 24 hrs. than could be secured from the steam locomotive.

When steam locomotives were used, a train required about 7 min. to pass through the tunnel and clear the block signal before another could enter it. With electric operation the trip is made in 3 min. One other very important quality possessed by these locomotives is a characteristic belonging to the kind of motors used, which is that when running down grade with no power supplied to the motors from the overhead wire, they act as dynamos generating electric current and returning it to the line. The very fact that the motors are acting in this manner while the train is running down hill under the influence of gravity, holds the train back, because its energy is partly transformed into electricity which is returned to the line and helps other trains and makes for economy. The more power that is returned to the line by the engine coasting or drifting, the more is it and its train retarded; and on the West Virginia grades of the Norfolk & Western, these 3,250-ton trains are let down the hills at 15 m. p. h. by reason of this feature of the electric motor, and air brakes are used only to bring the train to a full stop. Air for the brake system is supplied by a motor-driven compressor similar to those employed on the New Haven and other electric locomotives. Besides the advantage of another means of controlling trains in addition to the air brake, the regenerative electric control referred to above appeals to railroad men because it diminishes the wear and tear of brake shoes, brake rigging and wheel treads.



Arrangement of motors and driving gear.

This electrification is a forward step in the application of electric power to steam railroads. It demonstrates, as other electric installations on trunk lines have demonstrated, that the substitution of electric for steam traction is passing from a simple engineering problem to one of finance. If the money necessary to change from one system to the other is provided, engineers will find methods of solving the problem presented, whether this be a case of a busy terminal with many short-journey suburban trains or a trunk line with its varieties of traffic.



Heavy electrically driven train on the Norfolk & Western hauled by two units as one.

REFLECTIONS ON MR. GAINES' ADDRESS

By Chas. E. Strain, Genl. Foreman, Hocking Valley Railway.

The convention address of Mr. F. F. Gaines, which appeared in the August issue of the RAILWAY MASTER MECHANIC, brought forth some very good material for thought, as well as some good thoughts fully developed. Among these, I was impressed by this statement that, "Every member of this association should put himself in the attitude of the business man toward a dollar." I would like to add that it is the business of every member of the railroad organization, no matter how humble his position may be, to put himself in this same attitude. It is generally in the lower walks of railroading that small financial leaks develop and as it takes some time for those higher up to discover them, it not only embarrasses those in authority, but likewise tends to destroy their confidence in their subordinates, when these unstopped leaks are found.

I believe it is the duty of every foreman to be constantly on the lookout for a way to change his method of turning out the work in his charge, if he finds that he can by that change save time and money. It should be his pleasure as well as his duty, to have some system of investigation whereby he could be satisfied that those under him were putting forth their best efforts. We must remember that the sad thing about getting into a rut is that, the longer one is in it, the harder it is to get out. One is predisposed to think the old system is about as good anyway and does not require as much energy as to get hold of the idea of the business man and the dollar.

When an organization has gained the upper rounds of the ladder of efficiency, it has frequently been done by the exertions of young men. It is the young men who are accomplishing our best things today, in business. The old men are apt to be set in their ways and often lack enthusiasm. To be sure, there are some men who never get old and these men are to the young man, what the governor is to the engine. An engine would soon run away and go to pieces without a governor, so would young men without the presence of some to steady their enthusiasm. But any daring foray or plunge into the real business of the day must be carried out by warm blooded youth.

Is it not a strong incentive for us in getting together an organization, to get hold of the young men and train them up to the business? If however, it is necessary to keep an old man because of his long service, get a young back back of him to do his pushing, so when he steps out, the young man will be competent to step up into his place.

We should be on the constant lookout for shop tools which will produce work more quickly than by the tools we are now using. This brings to my memory, that I once went to a foreman and asked for a tool to do a piece of work and he told me that a mechanic only needed a saw, hatchet and penknife, and as my time was not my own, as we often hear said about a day work shop, I went about the work in the best way I could with the tools at hand. The consequence was, that it took about twice as long to do the work and it did not look as well as it would, had I received the proper tools in the first place. Ever after that I was very reluctant to ask for any tool which would shorten the time it took to do a piece of work.

The piece-worker is constantly looking for tools or ways to produce work in a shorter time than formerly, and will suggest a great many things along this line that will help in the output of the shop. The foreman should be careful to avoid making the mistake which some have made, that as the man is a piece-worker, and his time is his own, letting him work his way out the best way he can, is very discouraging and detrimental to the kind of work produced. If a piece-worker does not get the shop tools which will help him do the work more quickly, he is apt to get it out in just such a condition that it will not be marked out. We have all made the mistake of allowing skilled labor to do work which could be taken care of by unskilled labor, just because it could be done along with their other work.

There are many ways in which one can save the dollars, if he will only be on the lookout, such as, reclaiming old material, being careful that new material is not wasted, seeing that when a piece of work is being done, that all things in connection with it are taken care of, such as watching the manufacturing of new material and not allowing more material to be used than is necessary. Here is a place where a great amount of money can be wasted and no one except the one manufacturing the product will know about it, so they should be very careful in ordering raw material, that there will be no more waste than is necessary to get the worked material out in good condition. Many of us have seen the time when work was being pushed and some change would come about, that we would be tempted to use what material we had at hand, rather than buy new material and make new formers, even though using material at hand was going to be much more costly in the long run.

The day has come when we have found that it pays to make a great many forgings cold, when we used to think it was necessary to heat them. We have often heard the old blacksmith say, "the devil will get the man who works cold iron," but we do not believe this now, and there are no set of men better equipped to handle his majesty cold iron than the smiths. I wish to give a few examples of some savings we have made since our foreman in the smith shop built a small air operated bulldozer, out of an old air cylinder and some other second-hand material about the shop, some of which would otherwise never be used again. The machine cost a little less than fifty dollars and has paid for itself many times over, in the two years we have had it. Here are the examples: Coupler raisers, each, hot .0125, cold .01; bend grab irons, each, hot .007 cold .004; operating levers, each, hot .01, cold .0045; operating levers, each, hot .015, cold .003; sill steps, each, hot .0065, cold .0015; still steps, center tread, each, hot .0035, cold .0008; sill steps, tread riveted, each, hot .015, cold .01; safety chain links, each, hot .0025, cold .0008.

These are only a few of many changes made and do not include the saving in fuel, which one can soon figure out for himself by figuring the cost per hour for running the furnace.

A contract has been given to the Luten Bridge Co., York, Pa., to build a 44-ft. span concrete bridge over the Cumberland & Pennsylvania tracks at Bowery street, Frostburg, Md. The town of Frostburg and the Cumberland & Pennsylvania will jointly pay for the improvements, which are to cost $5,340.

The only medal of honor awarded for rail joint products in the transportation department of the Panama-Pacific International Exposition at San Francisco, was awarded to the Rail Joint Company of New York.

The Cincinnati, Hamilton & Dayton Ry. will erect a new coaling station at Lima, Ohio, to cost $20,000. An oil house to cost $6,000 is also proposed.

The Industrial Sambrowne Belt

At the present day two figures stand out conspicuously before the public. They are the soldier and the artisan. The one typifies unproductiveness in peace and waste and destruction in time of war. The other is the creator of wealth and the great worker for the advance of civilization. A problem which has suddenly demanded attention, if not an early solution, has been set forth in a recent paper by Mr. F. B. Gilbreth before the American Society of Mechanical Engineers. The ending of the war will throw back into the ranks of the artisans many maimed and injured men, who have still some productive faculty left, if it can be properly utilized. Many such men will come to this country and Mr. Gilbreth's method will put work within their reach without a resort to charity. Our own industrial cripples also demand attention.

An example of what is outlined may be taken from military experience in order to explain the principle involved and show the direction in which good works may proceed. General Sir Samuel Browne commanded the expedition which in 1879 practically put the Kuyber pass under British control. Sam Browne had lost his left arm and in order to carry his sword and return it to its scabbord, the equipment bearing his name was devised. It consisted in a waist belt, with the top of the scabbard carried tight against the belt, and held in a close fitting "frog" like a bayonet. A cross belt passed up from the frog and over the right shoulder prevented any sag in waist belt or scabbard. The sword is not now used as a weapon, but it denotes commissioned rank. The Sambrowne belt enabled a one-armed man to draw and "return" his sword after saluting without the aid of the left hand. This and other advantages caused it to be adopted as part of the "service" uniform in the British army. The Sambrowne belt therefore is a device for making good the deficiency of an armless man.

Fig. 1. Motion picture of printer distributing type. Note pause before dropping piece.

It has been estimated that there are now 2,000,000 men in Europe who have suffered the loss of limbs, faculties, or both, as the result of injury in the great war. Mr. Frank B. Gilbreth has just returned from abroad where he has been studying for some months, methods of giving such men employment. Mr. Gilbreth says that the problem of adapting these crippled men to machines for manufacturing operations, or of even re-designing machines to fit the men, is a problem which will have to be solved in the near future not only in Europe but here in the United States to which a great number of these more or less helpless people are likely to come.

Mr. Gilbreth is an expert on scientific management, and his method of making his studies has been by means of the motion picture, not, however, of the ordinary kind in which motion is reproduced by taking photographs at equal intervals and projecting in the same manner, but pictures taken by a special apparatus called the chronocyclegraph. These pictures are analyzed not by projecting them, but by reading them one at a time. It has been very careful and laborious work, and this expert has not spared time nor energy and has now a mass of useful information at his disposal or rather he places it at the disposal of the Nation.

The question of re-designing machines to suit men is a problem that has a most inviting side to most Americans who possess just this kind of inventive ability. We have built locomotives which can work under either alternating or direct current, we have air brakes which can meet most diverse conditions and it is quite certain that many of our machine manufacturers if they set themselves to do it can devise machines where a one-armed man can, without excessive exertion, handle the output of a machine specially designed to make up the deficiency which "man's inhumanity to man" has thus cruelly thrust upon him. It is not only from the ranks of war alone that these maimed and halt individuals come. In our own country the constant, though fortunately lessening numbers of the injured, are still the heavy toll that our intense industrial life exacts from among the ranks of the toilers from all the forms of manual labor.

Perhaps one of the simplest problems which presents itself for solution in connection with industrial cripples or maimed soldiers is that of the one-armed man. Such a man having been deprived of one member is immediately seized with the feeling, emphasized in a thousand ways, that he is a one-arm man in a two-arm world. He begins to despair. It is one of the most important acts that can be performed by anyone engaged in beneficent or helpful work to explain, to show, nay to insist that what seems to the maimed man to be the impossible can be achieved, and is actually within grasping distance. The psychological effect of wholesome encouragement has here perhaps the most marked effect that can be found anywhere in human experience.

The types of injured men who can be helped by the scientific method are 1, men who have chiefly done mental work; 2, men who have done mostly physical work yet who are capable of being transferred to mental work; 3, men who have done nothing but physical work, and who if helped must be helped on the physical side.

When the study of motions is taken up and the moving picture in the more refined forms to which it can be brought are employed, the aim is to discover: First, what workers have been used for the work in hand; second, what motions may have been used; third, what motions must be used; fourth, to discover what motions are possible for the proposed worker; fifth, the type of work best adapted to the worker. In fully analyzing the data thus derived, one is able to determine the type of work the worker can best do and also determine what is the best method by which he can be taught.

In the motion chart, if one may so call it, nearly all the motions of a man at work consist in whole or in part

of: 1, search; 2, find; 3, select; 4, grasp; 5, position; 6, transfer of hand loaded; 7, assemble; 8, use; 9, desemble or take apart; 10, inspect; 11, transport loaded; 12, pre-position for next operation; 13, release load; 14, transport hand empty; 15, wait—unavoidable delay; 16, wait—avoidable delay; 17, rest for overcoming fatigue. In all this record no incident is too trivial for careful notice and study as the intelligent analysis of minute actions or pauses may mean that a man imbued with hope may do good work in spite of seemingly insurmountable obstacles.

Our illustrations show the pictures taken in the study of motion. The first, Fig. 1, shows a printer in the act of distributing type. The lines of light are made by a small-sized electric bulb strapped on the hand, and each luminous line shows the path of the hand from the "stick" of type to the "font" in which it is dropped. The ball of light at the end of each line shows the momentary pause of the hand while the piece of type is dropped to the receptacle.

Fig. 2 exhibits a man drilling small cast iron cylinders, and the luminous line indicates a slight pause (for the exposure is the one-thousandth of a second), made by the operator, as his mental make-up hesitates for the briefest space of time in selecting the piece to drill. The line shows the minute pause in placing the piece and in the final adjustment.

Fig. 3 shows three lines, each the operation of lifting a photograph and placing it. The three lower curves are the turn of three photographs, and the upper and higher curves are the return motion of the hand. The pauses at each end of the curves indicate the brief but necessary delay in each of the three operations.

It is by the study of such curves that unnecessary motions are revealed, or unduly long pauses appear. When these are eliminated, as they often can be, and a thorough knowledge of the whole process dawns on the scientific expert, he is then so sure of his ground that he is able to render to the man bearing a physical disability, the paramount and vital service of imbuing him with that full and deep confidence that comes from intelligent and instructed courage.

One system of analysis which may be called the graphic method consists of drawing an upright line to scale rep-

Fig. 2. Motion picture of man drilling cast iron. Note pause in picking up and adjusting piece.

resenting the time occupied by any member of the body in performing some necessary part in the work. For example, if on the chart the time line. for the right hand be represented by an ordinate 4 ins. long, that of the head by 1½ ins., the body 3 ins., the right thumb 1 in., and the left hand by 1¼ ins. it is evident that the curve plotted from the ends of these ordinates represents the fluctuations of the body and limbs in the operation under consideration. The short time represented by the use of the left hand suggests a study of the whole chart in order to see if it is not possible to transfer the work done by the left hand to some other member, or to so modify the machine or the sequence of motions as to eliminate the left hand altogether, and so open the door of efficient work in this line to the one-arm man.

A story is told of a one-arm man applying for work at a factory. The foreman rejected him because of his lost

Fig. 3. Cyclegraph showing similarity of motions in performing similar actions.

limb, but said in a rather rough sort of joke, "wheeling coal in the boiler room is open to you." The man eagerly agreed to try and arriving at the boiler house and being given barrow and shovel, hastily took off his belt, threw it over his left shoulder, made a sling for the left handle of the wheel barrow and guided it with the right hand. He put the end of the shovel against his shoulder, made a forward body motion and step, loaded the shovel and raised it with his one hand and tipped the contents into the barrow. A careful appraisement of his work revealed the fact that on the first day with work to be done amid unknown surroundings, a non-helpful atmosphere about him and his environment strange, he performed 68 per cent. of the work of two-hand men who felt "at home" and among friends.

Slight modifications of machines permits the assigning their operating and controlling parts to the remaining limbs of maimed workers. They may have to be taught to make the most of their motion possibilities, and this should be the contribution of the engineer in the field of social betterment.

The need of a new and humane view of such industrial possibilities is being forced upon us and the war has shown that the call to deal with it specifically is sudden and sharp. It is not a thing which may one day become obsolete, it will always be a present and a pressing necessity. We may now have offered to us a chance to throw around the needy, the broken, and despairing, what will be a powerful industrial Sambrowne belt, which shall exclude the weapon and all that may destroy, but shall hold within its benificent grasp the hopeful, useful lives of those that otherwise would be lost. It shall bind up not only the shattered and crushed limbs of the stricken body but shall hold the heart of each worker strong and steadfast in the noble effort to struggle on, perhaps to suffer, but to surely win.

SMOKE PREVENTION

Some interesting facts were brought out concerning railway practice in Chicago under the city's smoke inspection by-law. Mr. E. W. Pratt (C. & N. W.), chairman of this committee of the M. M. Association, said that the Ringelmann method of determining smoke density was in use and the unit used was the "engine-minute."

An engine-minute covers the observation of one locomotive during the entire minute. During this minute, 14 seconds or less is not counted; 15 to 45 seconds is counted as one-half minute; 45 to 75 seconds is reported as a full engine-minute. The density of smoke is obtained by its comparison with the Ringelmann chart, as published by the U. S. Bureau of Mines.

In order that the city inspectors shall read the smoke density correctly, applicants for these positions pass through a probationary period, during which time, under the direction of an experienced inspector, they make thousands of smoke readings with a full-size Ringelmann chart set up 50 ft. from them in the direction of the stack under observation. These men are under Civil Service, and their standing is based largely upon their ability to correctly read smoke density.

The members of the Railroad Smoke Inspectors' Association and the city inspectors frequently have joint classes in the reading of smoke density, in order that uniformity may be obtained in the case of independent individual observations.

One of the encouraging features of this plan of co-operation is that it has so fully met with the approval of the city smoke department that the latter has voluntarily opened all its record books, pertaining to railroads, to members of the railroad bureau, and most remarkable has been the reduction in the percentage of density of railroad smoke during the past few years, shown as follows: 1910, 22.3 per cent.; 1912, 10.74 per cent.; 1913, 6.00 per cent.; 1914, 7.41 per cent.

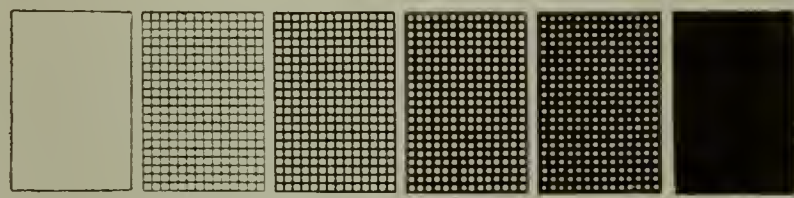
The figure for 1914 was made up from the summer reading of 1914 by old method, and the reading for September, October and November, 1914, by the new method. This figure would be lower but for the change in method. In closing, mention should be made of the fact that the Chicago city smoke department from its inception not only sought but has received the co-operation of the railroads.

In the discussion of this report, Mr. M. D. Franey of the New York Central gave a brief description of what he called a smoke washing apparatus which is in operation at the Englewood roundhouse of that company. About 100 locomotives are handled at that point every 24 hours. The apparatus is operated by a fan 78 ins. in diameter. The shop has a duct, run along the roof where the smoke jacks usually are. A telescope jack fitting closely over a locomotive smoke stack connects locomotive and the overhead duct. The action of the fan draws the smoke from the locomotive and delivers it into hot water vats.

By means of baffles the smoke is enveloped by the water several times before it reaches the chimney. The carbon and any other solid matter is collected in the water as foam, while the remaining gases pass out clean and free from soot. Eight or ten barrels of practically pure carbon is thus extracted from the smoke. A disadvantage of the process is that the acids produced act injuriously on the metals, and even eat away the concrete material of the vats. The best material used so far for this purpose is called Transite. Unofficial figures go to prove that there is a saving of fuel on engines standing in the shed. Answering Mr. Pomeroy, the speaker said a good deal of carbon had been deposited but he was not prepared to say if it had been used so as to become a "paying proposition."

Mr. Wm. Elmer, Jr. (Penna. Lines), stated that for several years the Buffalo city council had tried to agree on an ordinance which would be satisfactory to railroads and manufacturers. Even without an ordinance the railroads had done good work toward smoke abatement. The railroads are anxious to do their part and so forestall any drastic measures which might be introduced.

Mr. E. W. Pratt (C. & N. W.) said he had not much to add to the report but would urge those who had not gone to the trouble and expense that his road had gone to in the matter of smoke prevention should go in for smoke abatement before the authorities forced them to take action. If that policy had been pursued in Chicago, he believed that the expensive alternative of electrification would not have been forced upon them. The final report regarding electrification has not yet been made public, but it will cost approximately $192,000,000 and betterments, etc., due to change of motive power. It will cost about $100,000,000, or even double that sum, or larger than that, and the railroads will have to do some business in order to provide for the interest on that $300,000,000.



0 1 2 3 4 5

Ringelmann Scale for Grading Density of Smoke.

FUSIBLE PLUGS FOR BOILERS

The ordinary fusible plug as a safety appliance for boilers is familiar enough to those who have to do with the building and operation of steam boilers, but the composition of the fusible metal does not seem to have received all the attention it deserves. Messrs. Burgess and Mercia, in a communiation to the American Institute of Metals, calls attention to this very important feature of the plug.

Tin is the metal usually employed as the fusible portion of the plug, or at least what is said to be tin is made use of. An analysis of about a thousand plugs, new and in service, have been made by the Bureau of Standards, in which they find that the plugs which did not give the service expected were not made of pure tin, but contained from 3 to 5 per cent. of lead or zinc. The presence of these foreign constituents has the effect of raising the melting point of the so-called tin plug to 1,600 degs. C. and further, that when the metal did melt it did so in such a way as to prevent the proper blowing out of the plug.

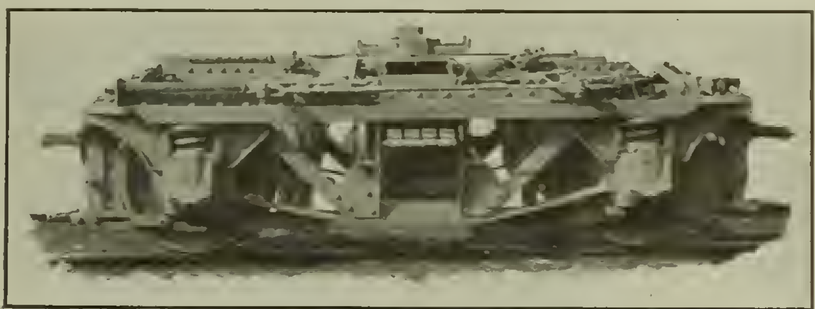
The impure tin is subject to oxidation and this may take the form of a sort of network beginning at the water side and gradually permeating the mass. The other form is where the oxide does not extend throughout the tin, but forms an oxide plug at each end of the fusible material. The fusible plug, therefore, may become "stopped" at either end by what amounts to a plug of metal having a higher fusing point than the pure tin out of which it is supposed to be made. The importance of tin, say, 99.9 per cent. pure, is insisted on, and it is suggested that specifications should be drawn in which Banca and a few of the purest varieties are called for.

The Dallas Union Terminal Co. will construct a heat, light and power plant to supply the terminal now being built at Dallas, Tex. The estimated cost is $60,000.

Erie All-Steel Passenger Cars

The Erie Railroad have recently put in service some all-steel coaches which possess a number of interesting features. The structure of the cars shows a careful and intelligent study not only of conditions as they are, but provision has been made for electrification when that becomes necessary; but the appreciation of the danger to life and limb to which all travelers are exposed in railroad travel has been observed, the cause of mishaps and disasters have been fully and scientifically appraised, and each damaged or shattered car structure has been made to disclose its weak parts and its point of deformation and failure, not only in the severe service test of daily use, but in the supreme trial of derailment and collision.

The cars were designed under the direction and supervision of Mr. William Schlafge, the general mechanical superintendent of the Erie, and these designs were approved by Mr. F. D. Underwood, president of the road. The firm of L. B Stillwell, consulting engineers, worked out the details with an eye to moderate first cost, the safety and comfort of travelers, and low cost of operation and maintenance. In the matter of safety, the behavior of steel cars in all kinds of wrecks was examined for the purpose of finding the parts which invariably gave way under any or all kinds of impact. Such parts were much strengthened in the Erie cars. The floor construction was made stiff and solid, and in order that the rest of the car might come up to this standard the wall-plates and posts and braces were so disposed as to successfully resist collapse or telescoping in case the car was overturned or received a heavy driving blow on one end. When this had been attended to, the roof of the car was brought up to an approximate and necessary equality of strength by the side posts being bent over at the top, so as to form heavy knees, and connected by a continuous deck sill 5 x 3-16 ins. steel plate. This design is equivalent to a top flange for the girder which is made by the side construction of the car.



Non-equalized coach truck for Erie cars.

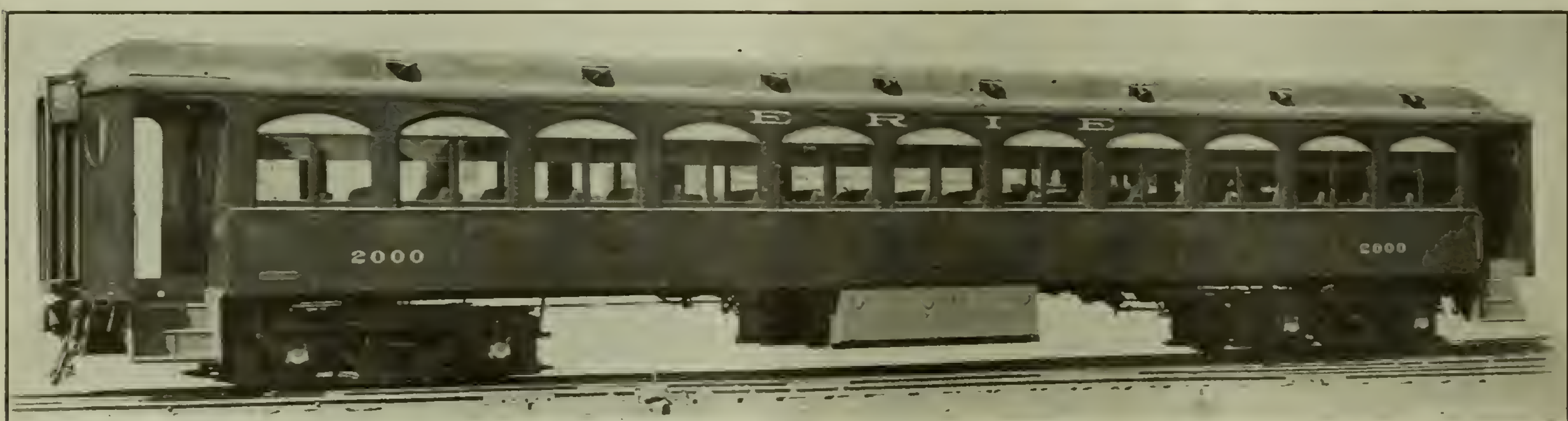
The traveling passenger is thus inside a stiff, non-collapsible steel box, which resists tearing or deformation by violent shocks from without. To put the serious idea here evident into poetical form, the whole car approximates to the wonderful "One-hoss shay" described by Oliver Wendell Holmes—"And the pannels just as strong as the floor, and the back crossbar as strong as the fore, and spring and axle and hub, encore."

The vestibule end posts are made of 9-in. I-beams. These are securely framed into the sills and to the vestibule ceiling. The body end walls are fitted with ¼-in. pressed steel corner posts 12 ins. deep, and ¼-in. gussetts connect bulkhead, or car end walls, to side sills and top plates, so that the end walls of the car are capable of resisting a very heavy blow.

In this car the ordinary belt-rail is absent, because the side of the vehicle is made of a series of T-shaped pressed steel upright posts, with diagonal braces at the bottom. These meet below the center of each window opening. The arch over each window has been designed deep enough to give strength approximating to the diagonal braces below. The roof is not merely a flimsy head-covering, but is here a continuation of the bridge-girder idea, as evidenced by the construction of the sides. The side sheets are made from American ingot iron and are 1-16 in. thick. This material was selected on account of its rust-resisting qualities when rolled in thin plates. In the possession of this quality it is superior to steel. The side of the car forms a truss girder 7 ft. 5 ins. high, which is more than twice the height of the girder that can be used with a heavy belt-rail at the window sills.

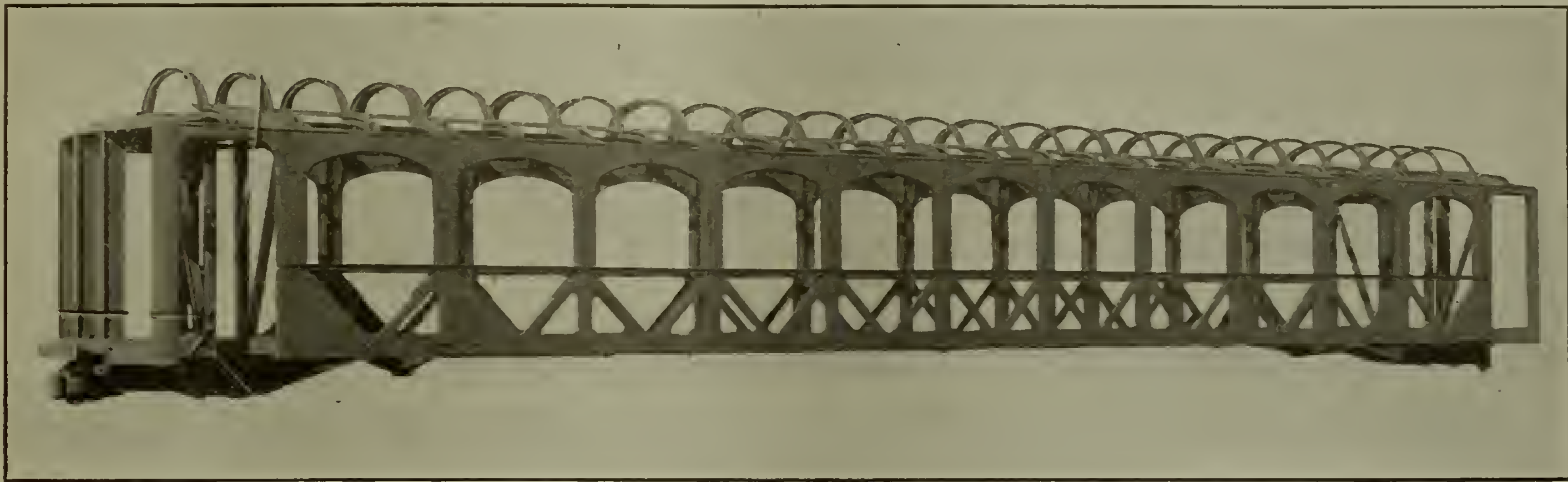
The rule for computing the rigidity of a girder is that the deflection varies as the cube of the height, and the strength varies as the square of the height; therefore it follows that in this car the rigidity of the whole side system is more than 2½ times what is would have been, with equal strength, and the girder extending from the floor up only to the window sills. Compared with the underframe style of construction, where no side girder is used, the rigidity of this car is 7 times greater even with equal strength. The practical elimination of nearly all the deflection usually present causes this car to have a much decreased tendency to spring, or "work," at the joints in the roof and between top plates and side posts. Thus the rigid car is less costly to maintain than one where there is a tendency to work loose at riveted joints.

The characteristic rigidity of a steel underframe makes advisable the employment of an adequate buffing device. These cars are, therefore, equipped with a gear capable



Erie Railroad all-steel passenger coach, capable of being readily equipped for electricity.

of absorbing an impact shock of 400,000 lbs. The center sills of this car are two 8-in. channels, made into one column by the use of a top cover plate 19 x ⅜ ins. and two 4 x 3½ x ⅜ in. angles riveted to the bottom flanges. These center sills are 14 ins. apart. The draw gear is necessarily placed below the center line of the center and end sills, and the bending moment produced in the structure by the eccentric load on the draw gear is resisted by the deep pressed-steel draft sills extending through the bolsters, and is transferred by the body end sill and bulkhead, or end-wall construction, to the high side frames. In this way the whole effective cross section of the car is called into requisition, and not merely the draw sills and the immediate center construction. The whole car framing and floor is practically a through bridge, with the floor united to the sides, and the sides joined to the roof members.



Steel framing of Erie passenger coach, showing heavy gusset plates back of door.

The table of comparative weights here given is interesting, as it contains an item not usually brought out: The table takes note of the fact that the dead weight hauled per passenger carried is a significant figure. In Great Britain the dead weight per passenger is less on the average than with us, though we easily surpass the United Kingdom when freight cars are considered in the light of tare weight as related to paying load. The explanation in each case is satisfactory. In passenger travel, English railways are shorter than ours, and the long through trains on which a passenger lives several days are unknown across the water. In England, their goods traffic, equivalent to our freight, is more like a magnified express business than anything else. They have no long, unbroken hauls for half a thousand miles, made up of coal, ore and other rough freight. These long runs go against us in passenger service, but tell in our favor in freight traffic.

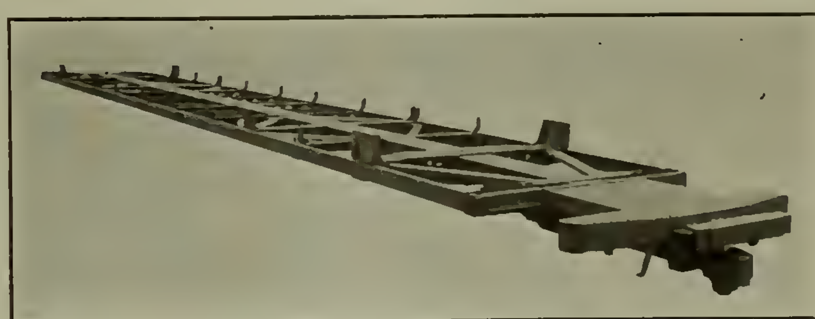
Interior frame Erie car, showing strong roof construction.

The table for Erie cars is as follows:

COMPARISON OF WEIGHTS OF NEW AND OLD PASSENGER CARS OF THE ERIE RAILROAD.

No. *Item*	*All Steel*	*Steel Under-frame*	*Steel Under-frame*	*All Wood*	*All Wood*
1. Number of seats.........	86	72	72	72	72
2. Average weight, lb.......	95,400	96,500	100.500	83,200	86.600
3. Weight per seated passenger, lb.	1,100	1,340	1,400	1,140	1.200
4. Weight of lighting.......	St. Bat.	St. Bat.	St. Bat.	Gas	AxleGen.
equipment, lb.	8,000	8,000	8.000	2.000	6.500
5. Net weight ex. lighting equipment	87,400	88.500	92,500	81.200	80.100
6. Weight per seated passenger, exclusive of lighting equipment	1,017	1,230	1.284	1.128	1,112
7. Length overall............	70′ 4″	66′ 3½″	66′ 3½″	66′ 3½″	66′ 3½″
8. Weight per ft. ex. of lighting equipment	1,243	1,333	1.395	1,225	1.210

In this table, item No. 3 shows the dead weight hauled per passenger. Item No. 6 shows the dead weight per



Floor frame of Erie car, showing level center sill.

passenger after the weight of the lighting equipment has been subtracted. It appears from item No. 4 that the lighting equipment, which contains heavy storage batteries, is far in excess of gas and axle light, often used in wooden cars, and if the weight of the lighting outfit was not withdrawn the comparison per seated passenger would be manifestly untrue.

The new 44-ton, all-steel car is 72 ft. overall and is now in service on the steam-operated Erie Railroad, but the design provides for the installation of electric motive power equipment when that becomes necessary. The

weight of the car complete with trucks, exclusive of lighting equipment, is 87,400 lbs., or an average of about 1,243 lbs. per lineal foot.

The comparatively light weight of the new car, as compared with other steel cars in similar service, is due to the system of design developed by Mr. L. B. Stillwell and Mr. Frank M. Brinckerhoff, for the Hudson & Manhattan Railroad and the New York, Westchester & Boston Railway. Their design excludes unnecessary members, and at the same time they have co-ordinated members that are used to develop full structural value. The heavy fish-belly center sill has been eliminated, and a center sill of uniform section extends from end to end of the car. In order to develop the full strength of the center sill as a column, it is supported by cross bearers at each main side post.

One of the things which touches the comfort of the passenger is the easy riding of the coach, owing to the style of truck which has been designed, and which is a clean departure from usual practice. The new truck is not equalized. It is of the riveted arch bar type, carefully designed and built. The truck has a steel frame, and the journal boxes are held in jaws which permit an up-and-down motion. On top of each box is a helical spring, which absorbs much of the "jolting" of the wheels. The bolster is set in the center and the weight of the car reaches the truck through a pair of quadruple, sensitive elliptic springs of ample spread. The car body rests upon a strong truck bolster and is floated upon the elliptic springs. Thus the car is held up on sixteen elliptic and eight helical springs, making twenty-four springs in all. The brakes are of the "clasp" type. The success of this non-equalized truck inevitably raises the question as to the why of the prevalent preference for the equalized truck. Future practice and tendencies will no doubt answer the question. The trucks, complete with clasp brakes and 33-in. wheels with 5 x 9-in. journals, weigh 12,500 lbs. each. A strong point in these trucks is a Coleman bolster-locking center-pin, which prevents the separation of car body from the truck in case of derailment or collision.

The interior of the car is sheathed in fire-resisting Agasote. The insulation of the car is made up of ¾-in. Flaxlinum fastened to the outside sheathing by pins welded to the frame and bent over washers. Otherwise the railway standard parts have been used, so that renewals can be easily and quickly made. The lighting is done by eleven electric fixtures arranged along the center line of the car. The curve of the ceiling is such as to reflect and distrbute the light over the seats and aisle, without producing unnecessary shadows. One 25-watt lamp is used in each fixture. The car is equipped with storage batteries of 800 amp. hour capacity. The Pressed Steel Car Company, of Pittsburgh, built these cars for the Erie Railroad.

The new Erie cars may fairly be said to be modern vehicles in the true sense of the term. When used in long, fast, through runs they can be equipped with head-rests or cushions, which come above the level of the traveler's head and guard him against neck-breaking shocks which might otherwise come upon him. The non-collapsible coach is a distinct and welcome advance in car construction to-day, and if the passenger can prevent himself from being thrown down inside the car and so injured, he may be reasonably sure that no outside intruding force will endange life or limb. The car stove and the explosive oil lamp have long disappeared, the wooden car is being relegated to the scrapheap, and the protected and non-breakable passenger car now challenges our attention.

THE RESULTS OF IMPACT

Instances have been known where the sleeping passengers in a Pullman car have been undisturbed by a collision which wrecked the front part of the train on which they were traveling. Loss of life at the front end occurred, yet it is said that when these Pullman passengers arose in the morning they grumbled, without knowing the reason, at the slow progress of their train. Later they were filled with devout thankfulness at their escape from death.

Extraordinary as this brief narrative may appear, its probability is greatly heightened by the results of some tests made by Prof. Endsley of the University of Pittsburgh and which he communicated to M. C. B. Association in an individual paper on the "Impact between Freight Cars in Switching Service." Up to the present time no definite information has been published on this exceedingly important subject, which has grown in interest with the gradual increase of car capacity and load.

Without giving a description of the apparatus used, or following the method of test, it is sufficient to say that some unexpected results came to light. A string of eight or ten cars was placed on a slight incline. The brakes on the lowest car were set and the slack between the other cars was taken out by their being gently pushed together. The force of gravity on the slight incline held the cars together as a solid lot, all but the front car being perfectly free to move under the stimulus of a blow at the high or free end of the string.

A car was hauled away from them by an engine and was then run toward them until the required speed was attained; the engine then stopped and the free car drifted forward toward the string of standing cars. When the first stationary car was struck it received a sharp blow, the draw gear went solid, and the car was forced forward in each experiment from 4 to 12 ins. according to the force of the blow.

The curious thing that developed and which was recorded by the testing apparatus was that this first car showed that it had experienced the maximum force of the impact before it had moved one inch. The result of the blow delivered to this first car of the string was at its height before any appreciable force was exerted by it on the next car ahead. The movement of the first struck car was found to be exceedingly slow before the diminishing force of the blow made itself apparent between the third and fourth cars, and the motion of the first struck car was entirely stopped before the impact between the fourth and fifth cars occurred.

Some of the force of a blow was absorbed by the draw springs, but, as has been pointed out, this value becomes constant as soon as the springs go solidly together. The fact that the first struck car experiences by far the larger part of the force of the blow and that the string of standing cars does not respond as a whole shows that the string acts as a series of separate hindrances to the propagation of the effect of the impact.

In a rough and ready form of comparison one may say that the action of each car in the string is, in a way, an-

alogous to the agitation of air particles in which sound is traveling. In due time the sound dies away, and does not reach a distant listener, because the mechanical force of the original sound is compelled to overcome the inertia of the quiet air all along its path, and is, at last, too feeble to set up in the stagnant particles of air the wave motion which is the physical counterpart of sound.

As the first struck car experienced the maximum force before it had even moved one inch, it is fair to suppose that the greatest damage occurred to this car. and so it was found to be. In fact, Prof. Endsley says, the results he obtained seem to indicate that there would be just as great a force between the cars, if one struck another car, or struck a string of cars.

It appears that apart from the assistance rendered by the other cars in the string, by means of their centre sills, the first struck car fares as badly as it may, practically unsupported by the cars behind it. Exceptions may appear here and there for various reasons, but this is probably the cause for the greatest damage taking place on the first struck car.

The loss of kinetic energy in some cases amounted to 70,000 foot-pounds. This probably caused quite serious destruction of some part of the car. Loaded cars with bumper blocks gave higher impact force with less destruction of parts than when couplers and draw gear sustained the shock. The rule deduced from a study of the data obtained is, that the maximum force of impact for any given speed is almost directly proportional to the weight of the cars in impact.

DRIFTING THROTTLE FOR Q., A. & P. ENGINE

A locomotive of the Consolidation or 2-8-0 type, recently built by the Baldwin Locomotive Works for the Quanah, Acme & Pacific Railway, is a representative engine of moderate weight and capacity, equipped with fuel-saving devices. This locomotive weighs 158,200 lbs., of which the driving wheels carry 143,100 lbs. As the tractive force exerted is 31,600 lbs, the ratio of adhesion is 4.52, so that the full tractive force can be exerted with unfavorable rail conditions.

This locomotive is a coal burner, and has a long firebox placed above the frames. The equipment includes a "Security" sectional arch and a Schmidt type superheater having 22 elements. The steam distribution is controlled by 12-in. piston valves, which are driven by Walschaerts motion. An interesting detail is a new design of Rushton throttle, with drifting valve. In service it is believed to be good practice not to admit air to the cylinders of a superheater locomotive while drifting, as the temperature is frequently sufficient to cause the oil to carbonize in the presence of air. For this reason both vacuum relief and by-pass valves are sometimes omitted from superheater locomotives, dependence being placed upon the admission of a small quantity of steam to prevent the formation of a vacuum while the locomitive is drifting.

In the new Rushton throttle the drifting valve is placed in the top of the main throttle valve, and is operated by the regular throttle lever. The drifting valve has a lift of one-eighth of an inch before the main valve begins to open. Steam passes from the dome to the interior of the throttle pipe, through suitable openings in the upper part of the main valve. This throttle closes tight when the throttle lever is closed. The device is not in any way automatic. In order to open the drifting throttle it is necessary to pull open the throttle lever one or two notches, and when the train is brought to a stop the throttle lever must be definitely closed. A drifting valve, the builders believe, with this arrangement is more satisfactory than any automatic device which may be applied to a locomotive.

The locomotive for the Quanah, Acme & Pacific is fitted with vacuum relief valves, so that it can drift in the usual way. With the drifting throttle open, however, the pressure in the steam chest will be sufficient to keep the vacuum valve closed, and the engine will then drift freely, with a minimum tendency to develop pounds or to burn out the lubricant. With a little practice, enginemen soon learn how to handle the Rushton drifting throttle so as to obtain the best results.

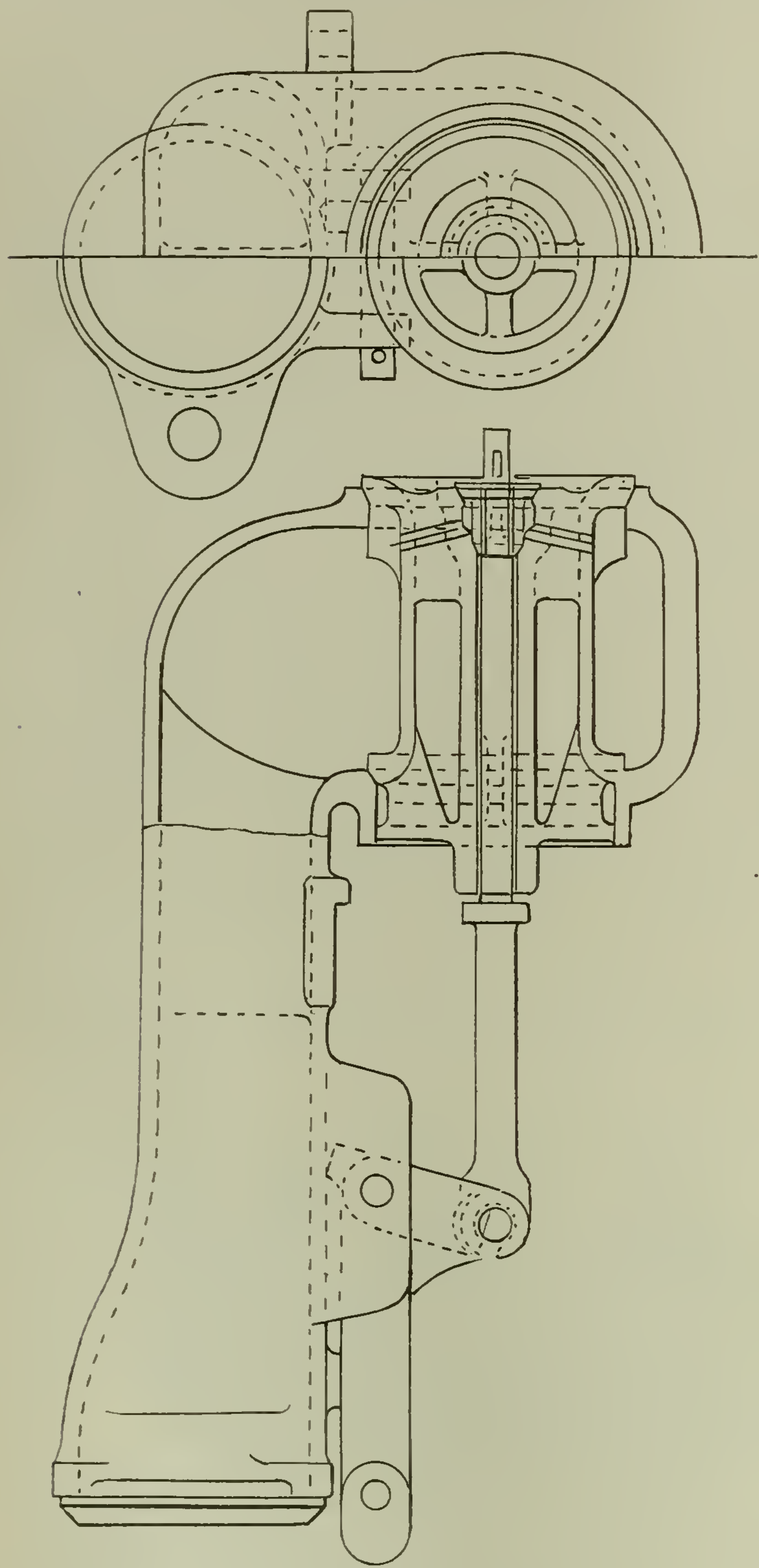
Years ago, before the conditions existed which are now met with, what is called a "drifting throttle," there was a somewhat similar arrangement got out by the Portland Locomotive Works, of Portland, Maine. The Portland throttle, as then made, was practically an ordinary throttle, but in the main throttle there was a smaller valve which was actuated by the throttle stem. The whole arrangement was such that the small valve opened first, being carried off its seat by the upward movement of the stem; then the main throttle valve opened as the stem continued to rise.

Closing the throttle reversed the process, and the

2-8-0 type for the Q. A. & P. with drifting throttle.

Robert Cray, V. P. and Gen'l Mgr. Baldwin Loco. Wks., Builders

small valve closed last; but when it was shut the dry pipe was completely cut off from steam. The object of the first-opening, last-closing, centrally placed little valve was said to be to prevent a rush of steam to the cylinders by a sudden main-throttle opening. The little valve admitted steam in sufficient quantity to heat the cylinder walls. There was no idea of preserving the lubricant. It amounted to a slow throttle opening, and that was the end sought and the idea in view. This valve was made twenty-five or thirty years ago, or even before that, and if any of our readers have an old blueprint or a sketch, or remember the valve and can throw any further light



Rushton drifting throttle valve.

on the subject, we will be very happy to hear from them. The function of the modern drifting throttle is different from the old Portland auxilary valve, but it may not be so very different in mechanical construction, if one could see an old print, drawing or sketch.

Our illustration clearly shows the construction of the throttle valve, which has been applied by the builders to a number of recently built locomotives of various types. The general design of The Quanah locomotive, and the leading dimensions of the engine are given for reference:

Gauge, 4 ft. 8½ in. Cylinders, 20x26 in. Valves. Piston, 12 in. diam. Boiler—Type, wagon-top; diameter, 64 in.; thickness of sheets, ¾ in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial. Firebox—Material, steel; length, 107⅝ in.; width, 42 in.; depth, front 70¼ in., back, 66 in.; thickness of sheets, sides ⅜ in., back ⅜ in., crown ⅜ in., tube ½ in. Water Space—Front, 4 in.; sides, 3 in.; back, 3 in. Tubes—Diameter, 5⅜ and 2 in.; material, 5⅜-in. steel, 2-in. iron; thickness, 5⅜-in. No. 9 W. G., 2-in. No. 12 W. G.; number, 5⅜-in. 22, 2-in. 165; length, 12 ft. 10½ in. Heating Surface—Firebox, 167 sq. ft; tubes, 1,501 st. ft.; firebrick tubes, 22 sq. ft.; total, 1,690 sq. ft. Grate Area—31.4 sq. ft. Schmidt superheater. Heating surface—319 sq. ft. Driving Wheels—Diameter, outside 52 in., center, 46 in.; journals, 8½x9 in. Engine Truck Wheels—Diameter, 30 in.; journals, 5x8 in. Wheel Base—Driving, 14 ft. 3 in.; Rigid, 14 ft. 3 in.; total engine, 21 ft. 10 in.; total engine and tender, 55 ft. 6 in. Weight—On driving wheels, 143,100 lbs.; on truck, 15,100 lbs.; total engine, 158,200 lbs.; total engine and tender, about 290,000 lbs. Tender—Number of wheels, 8; wheel diameter, 33 in.; journals, 5½x10 in.; tank capacity, 7000 gals.; fuel capacity, 12 tons. Service—Freight.

FLEXIBILITY AND RIGIDITY

As long as locomotive boilers are built as they are, there is one important matter outside the calculated efficiency of riveted joints, or the factor of safety, and that is the staybolt question. We do not say that these other matters are not important, for they are exceedingly important, but the staybolt matter had some new light thrown upon it at the last Master Mechanic's convention.

On page 274 of our August issue we called attention to some special work done by Mr. Geo. L. Fowler in an endeavor to ascertain the relative movements of the sheets of a locomotive boiler when being fired up and when "hot." According to the results of these carefully conducted tests, it appeared that the average amount of movement for a flexibly stayed boiler, compared with one with rigid stays, was as 2 is to 1. The flexible staybolts (and Tait flexible staybolts were experimented with) showed that these bolts permitted the boiler to do what it wanted to do, that is, to slightly alter the relative position of its plates more freely than the rigid bolts did. In fact, they allowed twice the amount of movement that the rigid bolt permitted.

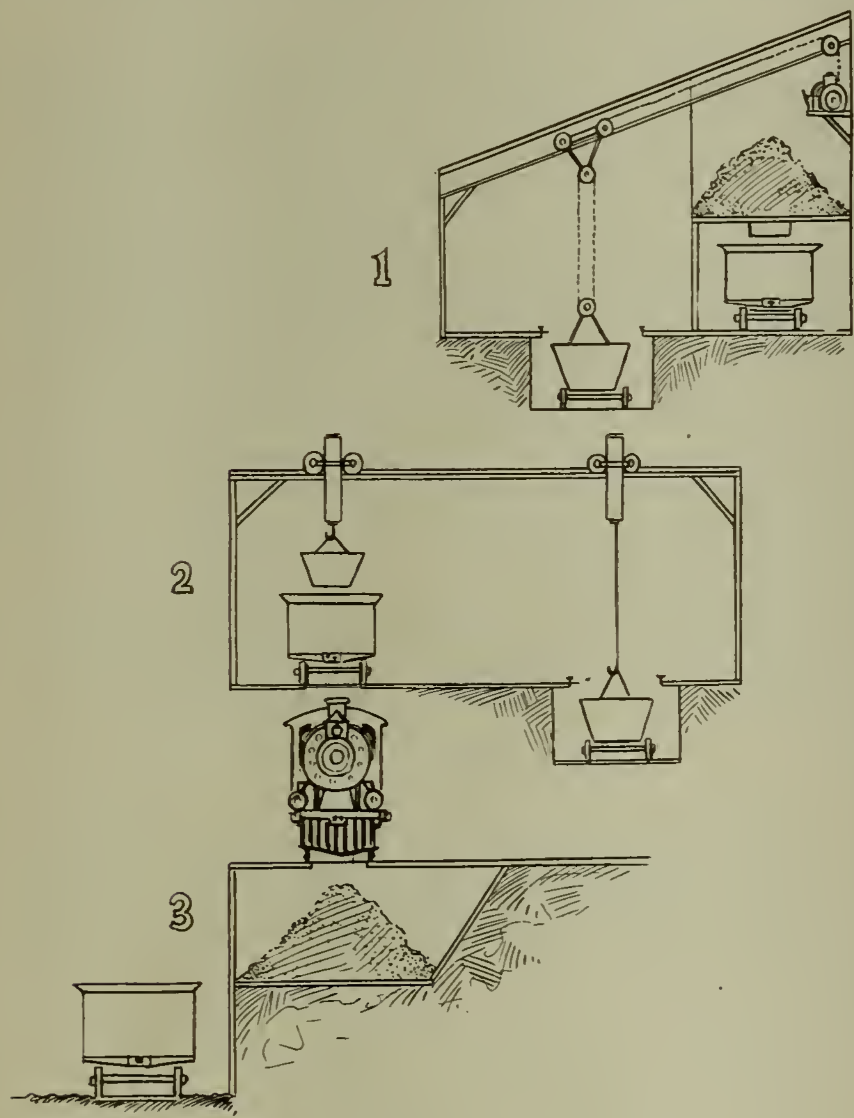
It is, in short, the old story of the sturdy oak and the pliant sapling in the storm. The sapling bent over and lived and the oak resisted and was broken. In any arrangement of steam piping there is always an expansion joint, not to resist movement, but to facilitate it. The boiler, acted upon by the same law, is benefited by similar treatment. In the experiments made by Mr. Fowler he found that the staybolt is in constant motion while the boiler is hot. It is always bent when under stress.

Some years ago a locomotive was rigged up at the Collinwood, Ohio, shops of the L. S. & M. S. Ry to test the action of long tubes, when the engine was worked hard. The experiment revealed the fact that the long tube did not vibrate, as many had supposed, but when the boiler was "pushed" the long tubes, while holding tight at either end, actually sagged down in the center as the great volume of hot gas passed through them and expanded them.

The more we study the locomotive boiler in its behavior in hard or even under average conditions, the more it seems forced upon the railroad man's attention that the boiler is doing, and intends to do, something that we cannot successfully oppose in the long run. We do not oppose the expansion of steam pipes, we provide for it. We do not try to hinder the expansion of rails in the track, we allow for it, we expect it when we make a pattern for the foundry, and we set a steel bridge on rollers to take care of it, and to use flexible staybolts looks like the logical thing to do with a steam boiler.

PNEUMATIC ASH HANDLING

There are many and various ways of handling locomotive ashes at round houses or other terminals, and among these some information has been gleaned from the Guarantee Construction Company. Speaking of some of the ways employed our informant says the Pennsylvania Railroad usually installs either the skip hoist with overhead runway extending up into an elevated bunker from which the ashes are discharged to gondolas. The Link Belt Company have installed a number of these. Other roads sometimes use an overhead track, crossing two or more railroad lines, and from the overhead track is suspended a steam or compressed air cylinder which lifts the ash-tubs out of the pits between the rails, after the tubs have been filled with ashes, and discharges them into cars. Several of the roads use an arrangement by which the locomotive track is placed about 10 ft. higher than a depressed car track alongside. The elevated track has a concrete shelf beneath it. The ashes are dumped onto this shelf and shoveled over to the empty cars standing close by. The Erie at its Jersey City terminal uses long trenches beneath the tracks into which the

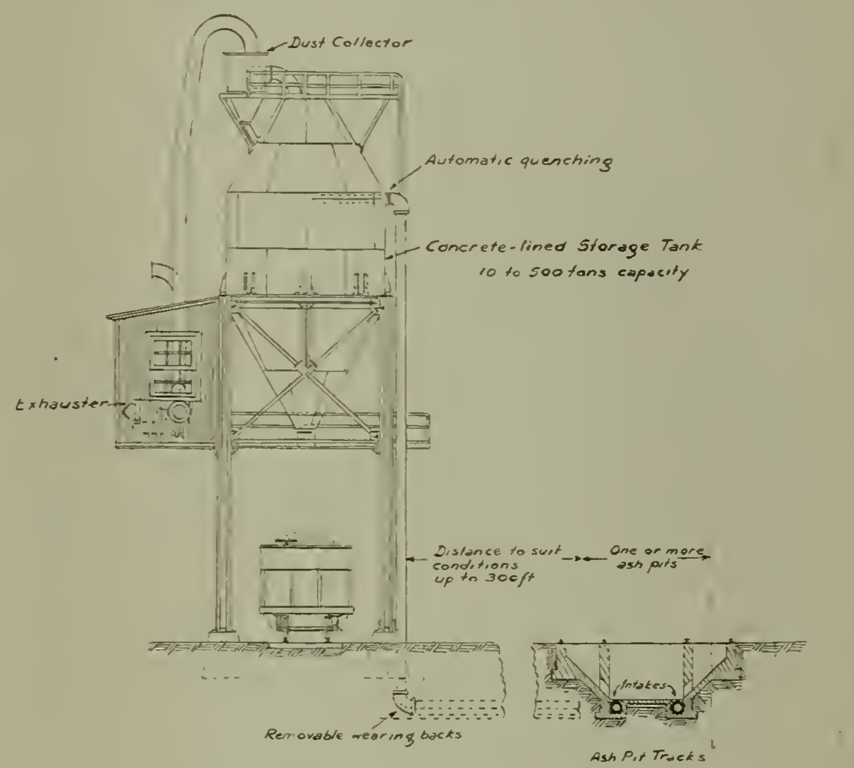


1. Overhead inclined track with motor.
2. Air hoist system.
3. Hand shoveled ashes from different levels.

ashes are delivered during the day and at night a locomotive crane transfers the material to cars.

The general arrangement of the Darley Pneumatic System applied to this service is shown in our illustration. An overhead ash storage tank or bunker of any desired capacity is arranged to deliver the material directly to cars by gravity. A reduction of pressure of about 3 lbs. per sq. in. is maintained within this closed tank by a centrifugal exhauster direct connected to a motor. The exhauster may be carried by the tank structure or put in some adjoining building to suit particular conditions.

The conveyor duct is a 10 or 12-in. heavy cast iron pipe extending along the ash pits of one, two or more ash service tracks. The ash intakes are directly in front of the ash pits. A very powerful draught is induced in the conveyor duct because of the reduction of air pressure in the tank, and the ashes are drawn into the intakes and conveyed in suspension to the tank. Just outside the tank is a water spray, which automatically quenches the material in transit. Practically the only point of wear is at the elbows, which are protected by removable wearing backs of manganese steel. There are



Darley Pneumatic system of ash handling.

no moving parts in contact with the ashes and the operation is rustless and noiseless. The handling capacity of a 10-in. system is approximately 600 lbs. per minute. The handling capacity of the 12-in. system is approximately 1,000 lbs. per minute. The conveyor duct may be set in any desired direction or it may be carried under any number of tracks. The limit of distance would be about 500 ft.

PIG IRON AT PENHSIHU, CHINA

It had been previously estimated that the output of pig iron at the Penhsihu Colliery & Mining Company's plant for the current year would be 36,000 tons, so says a recent Commerce Report, issued by the United States Government. Of late, however, the average daily output is 120 tons, and at times as high as 147 tons, so the output at the end of the year is expected to surpass the estimated amount.

The quality of the product is becoming more widely known. The percentage of phosphorus and sulphur contained in pig iron are generally accepted as a means of grading its quality. In ordinary cases pig iron contains about .0024 or .005 of phosphorus and sulphur, while Penhsihu iron contains .00038 or .00044, respectively. Ordinary pig iron being quoted at $17.50, Penhsihu iron is worth about $35. At Newchwang the selling price is quoted at $20 per ton, which is $4 cheaper than Shanghai iron.

He only is advancing in life whose heart is getting softer, whose blood warmer, whose brain quicker, whose spirit is entering into living peace.—*Sesame and Lilies.*

Thoroughly great men are those who have done everything thoroughly, and who have never dispised anything, however small, of God's making.—*Modern Painters.*

LOCOMOTIVE FACTS AND FIGURES

In the discussion which followed Mr. G. R. Henderson's paper on "Recent Developments in Locomotives," read before the New York Railroad Club, some very interesting and instructive facts and figures were brought out. Among these, Mr. G. M. Basford pointed out that it is important to note that the steam locomotive of to-day is, as regards efficiency, on an entirely different plane from where it was in the days when the electric locomotive first made its appearance. Electriciy has an entirely different competitor now than it had at first. In fact, the improvements in the steam locomotive have practically put back the day for the general use of the electric locomotive.

In eighteen years the steam passenger locomotive has increased three-fold in tractive power. Indicated horsepower, at the P. R. R. testing plant at the St. Louis exposition, eleven years was 1,641; recent records of a P. R. R. Pacific-type engine show 3,184, from the same testing plant, now at Altoona. A record of 3,580 ind. h.p. has been made on that road by a large freight engine traveling at 16 m.p.h. At St. Louis, in 1904, the plant showed 16.6 lbs. of steam and 2.01 lbs. of coal per ind. h.p. per hour; Altoona now shows 14.6 lbs. steam and 1.8 lbs. dry fuel per ind. h.p. per hour. In ten years a saving of 10 per cent. in fuel and 12 per cent. of water has been effected.

For the past five years boilers have been designed with reference to maximum cylinder horsepower. Much has been done to increase the effectiveness of draft appliances and exhaust nozzles. Greater attention has been paid to enlarged air opening below the grates. Super-heating and compounding have been worked out separately and together, with promise of further development. Feed water heating is a practical success. Brick arches have taken a prominent place with respect to combustion

Mr. Henderson credits the arch with 5 per cent. The arch undoubtedly contributes to the saving of the superheater, and helps to secure the advantages of improved boiler design. Each helps the other. Mechanical stokers contribute to increased capacity, in addition to whatever saving they may make. Improved valve gear has taken an important place in cylinder economy and capacity. Labor saving devices for engineman and fireman do good in that they enable these men to get the full service out of the machine, without additional effort.

We are beginning to use high grade alloy steels. These enable the designer and builder to reduce the weights of parts. They help not only to cut down the static loads on axles, but they assist in reducing the dynamic augment in counterbalancing. This is done by making the reciprocating parts lighter. Improved economy means increased capacity, and a good example may be had from the coal consumption record.

Assuming 6,000 lbs. of coal per hour as a fair figure for coal consumption. If 4 lbs. of coal are required per indicated horse-power per hour, the 6,000 lbs. would generate 1,500 indicated horse-power. If we were able to effect a saving of 25 per cent. of fuel, then 3 lbs. of coal would generate 1 horse-power for one hour, and our 6,000 lbs. of coal would be good for 2,000 indicated horse-power. This would mean that an economy of 25 per cent. in fuel would produce an increase of 33 1/3 per cent. in capacity.

To put it in terms of every day life: If a man had $6,000 to spend on any commodity, of which each piece was worth $4, he could buy 1,500 of these articles for the $6,000. If, now, the price went down to $3 each, he could get 2,000 of them instead of only 1,500. He would thus gain 500 articles, or his buying power would have increased 33 1/3 per cent. owing to a reduction of 25 per cent. in the price. Better than this has been done on seven railroads, which show a saving of 36 per cent. in coal per ton-mile.

BALTIMORE & OHIO COAL PIER

Authority for the erection of a new coal pier at the Curtis Bay terminal of the Baltimore & Ohio Railroad at Baltimore, which will cost approximately $1,500,000 and have a capacity of 10,000,000 tons a year, was voted by the directors of the company at a meeting held in New York last month. The new pier will be the largest yet built by the company and will provide facilities for the port of Baltimore. This will put the city in the position of a strong competitor for the coal trade on the Atlantic seabord.

Work on the improvement will be commenced as soon as the contracts can be let in order to secure the additional facilities as soon as possible, it being estimated that it will require eighteen months to build the pier. It will be of steel construction and fireproof throughout.

The plans of the new pier as designed by Mr. Francis Lee Stuart, chief engineer, and approved by the president of the road, embody a number of features for the rapid loading of vessels and reducing the breakage of coal to a minimum in handling shipments from cars into the holds of ships. In design the pier will consist of two car dumpers inshore, built in units and equipped with rapid-moving belts leading to movable towers on the pier which can load into vessels on either side or the entire loading capacity can be directed to one vessel.

The pier will be 700 ft. long by 115 ft. wide. The car dumpers will be capable of handling cars 53 ft. long and unloading forty 100-ton cars an hour. The belts for conveying the coal will be run at speeds of from 250 to 500 ft. a minute, thus giving a capacity of from 3,000 to 6,000 tons an hour.

Officials of the railroad point to the large increase in coal traffic handled at Curtis Bay during the present year as proving the necessity for the new pier.

THE DEMON WAR

The blighting effect of war has an example in the showing made by the Southern Railway the past year. Substantial changes in the industrial situation caused a falling off in receipts of $8,551,938, leaving only $1,523,369 as balance of income against $2,047,776 in the previous year.

The year closing June 30 last, began well in a business way for the Southern as well as for many other roads in the country; but the outburst of the European war introduced a situation which had an especially withering effect on the cotton industry of the South and all business generally in that section was paralyzed thereby. This forced sudden and extraordinary efforts in the way of retrenchment on the Southern which had already prepared for handling one of the largest cotton crops ever raised.

Gross revenue for the year amounted to $62,199,509, as against $70,750,966 for the previous year, while the operating expenses used up $46,174,710, as compared with $51,760,649 in 1914.

Of all the passengers carried during the year—16,500,000—only one was killed. This is an unusual record. In spite of radical retrenchments necessary the property in the main has been well kept up, which reflects credit on the management.

Practical Suggestions from Railway Shop Men

ANVIL BASE AND HANDY RACK

By C. K. Abbott, Foreman Blacksmith

The accompanying sketches show two inexpensive devices especially useful in a railroad blacksmith shop. Fig. 1 shows a rack that is handy for holding bolt stock and other short material that requires much handling in the process of cutting and transporting to the machine or place to be worked up. The ends slanted in, as shown in sketch, allows a number of them to be stacked upon each

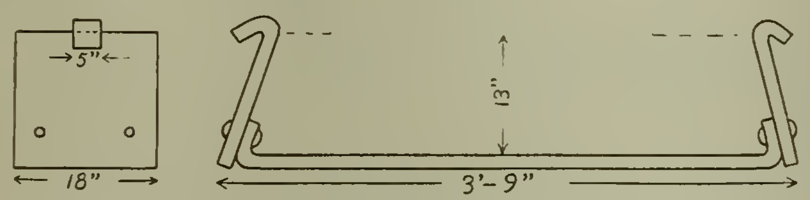


Fig. 1. Rack for Holding Bolt Stock.

other, either filled or empty. The lug on each end allows the rack to be lifted from place to place with a crane with a simple hook device. These racks can be made out of scrap boiler plate.

Fig. 2 shows an anvil base. It can be made of scrap material such as transoms, bumper plates, etc., and with small expense for labor. With anvil base made in this manner the anvil can be fastened securely to base, and allowing anvil to be placed to suit work. Base to be made

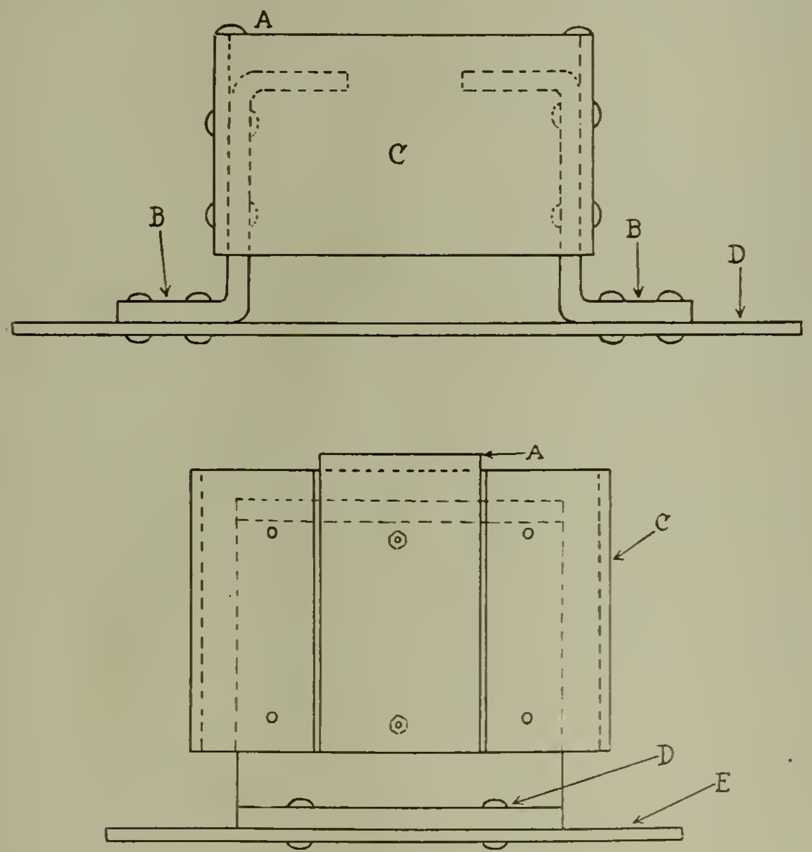


Fig. 2. Anvil Base.

to suit anvil in height and size. No wooden block to rot out. No unnecessary obstruction to work extending downward. No upsetting or sagging of anvil. No obstruction to feet of workman. The sides and bottom pieces are riveted on to the upright, the lugs "A" are fastened with two bolts so that anvil can be removed by simply taking out bolts.

Mingle prudence and foresight with imagination and admiration, and you have the perfect human soul.—*Lectures on Architecture and Painting.*

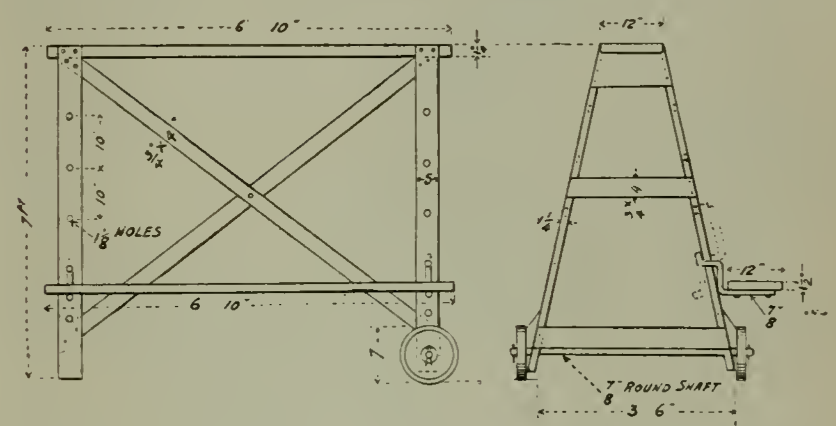
DRILLING TELL-TALE HOLES

By Chas. Markel, Shop Foreman, C. & N. W.

Since the federal boiler inspection law went in effect as to locomotive boilers one of the most difficult and expensive pieces of work to do is the drilling and keeping open of detector holes in stay bolts. These holes must be 3/16 in. diameter, 1¼ ins. deep.

Our method on the C. & N. W. is to drill all detector holes after stay bolts are applied and riveted over. We have very little difficulty in drilling the new holes, as to breakage of drills, but had all kinds of trouble in opening up the holes after being in service on account of the holes filling up with rust and corroding. If the holes did not show the required depth it was almost impossible to get a drill to start cutting at the bottom of the old hole, which possibly required only to be redrilled ⅛ in. deeper, and in doing this we often used up three or four drills and quite often broke it off in the hole, which means to take out stay bolt, as broken drill in hole cannot be removed.

The attached sketch shows a wooden horse that was



Wooden Horse for Stay Bolt Drill.

designed by Boiler Foreman Wm. Kerr, which is used exclusively by the stay bolt driller. Note that the device can be readily moved about the shop by one man, as it is wheeled like a wheelbarrow. The foot board is adjustable as to height and will hold three men in it at its highest adjustment with no danger of tipping over. When not in use the foot board is folded up as shown by the dotted lines on the drawing. The chisel-pointed square piece of high speed steel shown is used in opening up old holes that are partly stopped up by corosion.

If a hole should require drilling, the chisel point on the end of square piece of steel is used in an air breast drill and as it is revolving it is pulled back and forth in the hole. The chisel point striking the bottom of the hole removes all scale, leaving the clean metal to start drill on if the hole requires drilling still deeper. We use turpentine as lubricant in opening up old holes with chisel pointed square reamer. We have only used four dozen 3/16-in. drills at this shop since January 1, 1915, when we began using the square reamer.

Great art accepts Nature as she is, but directs the eyes and thoughts to what is most perfect in her.—*Modern Painters.*

Every increase of noble enthusiasm in your living spirit will be measured by the reflection of its light upon the works of your hands.—*The Elements of Drawing.*

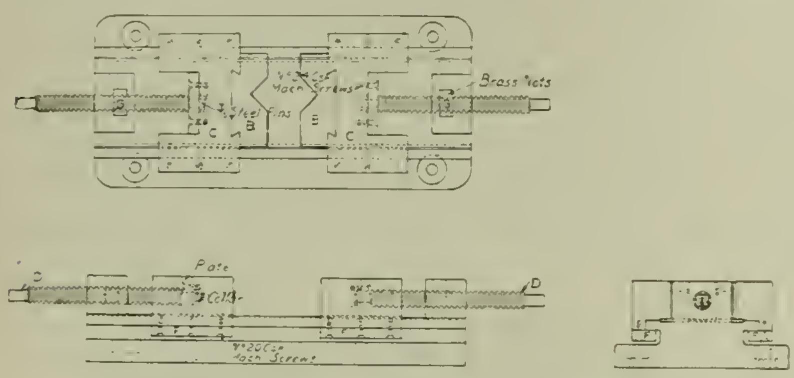
SIMPLE VISE FOR DRILL PRESS

By W. H. Wolfgang.

In the illustration "A" is shown a simple vise for holding small castings or forgings on the drill press or tapping machine, as all small shapes and forms of castings or forgings can be properly held with the use of steel or cast iron jaws to conform as near as possible to the material to be drilled or tapped. V-shape jaws as shown at B are the most common used.

The cast iron jaw heads C slide on base E and are held in place by steel guides F, which are secured on the jaw heads C, the jaw heads are dove-tailed to admit the V-shaped jaws B, and can be machined to suit, as every machine shop has its own dovetail standards.

The steel screws D pass through a brass nut G, which is held in place in the slots in base E as shown. The end of screws are connected to the jaw heads C by means of



Vise for Holding Castings or Forgings.

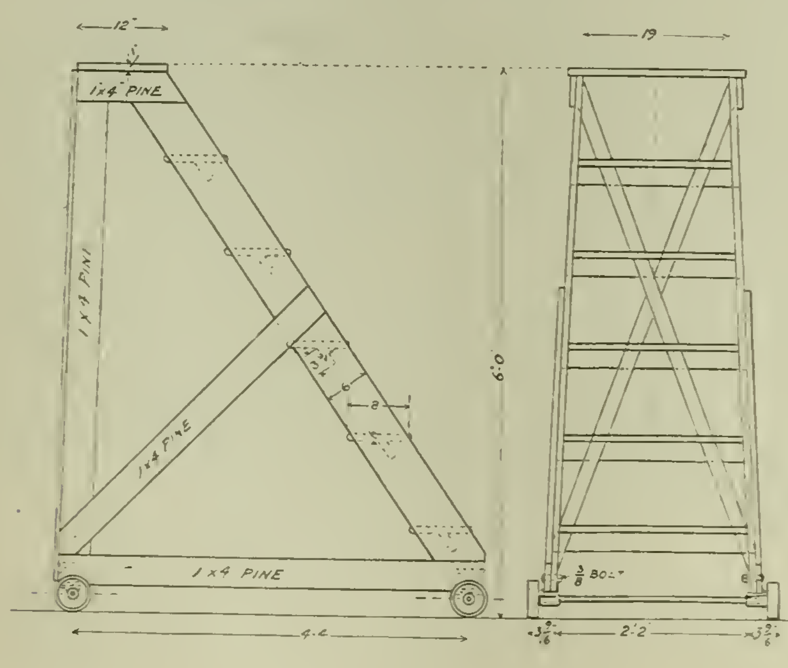
a collar H and steel plate J, the screw passes through the brass nut G and the collar H is pinned on the end, after the steel plate J is slipped on the end of screw, as will be noticed in the illustration.

A hand wheel or ratchet wrench can be used on the square of the screw D to be used in operating the vise, in some cases a hand wheel is better, but this must be determined by the operator as to which he prefers.

PORTABLE STEP LADDER FOR STOREHOUSE

By W. H. Wolfgang.

In the illustration is shown a portable step ladder for use in railway store rooms and warehouses where bins are built higher than a man can reach. All danger of

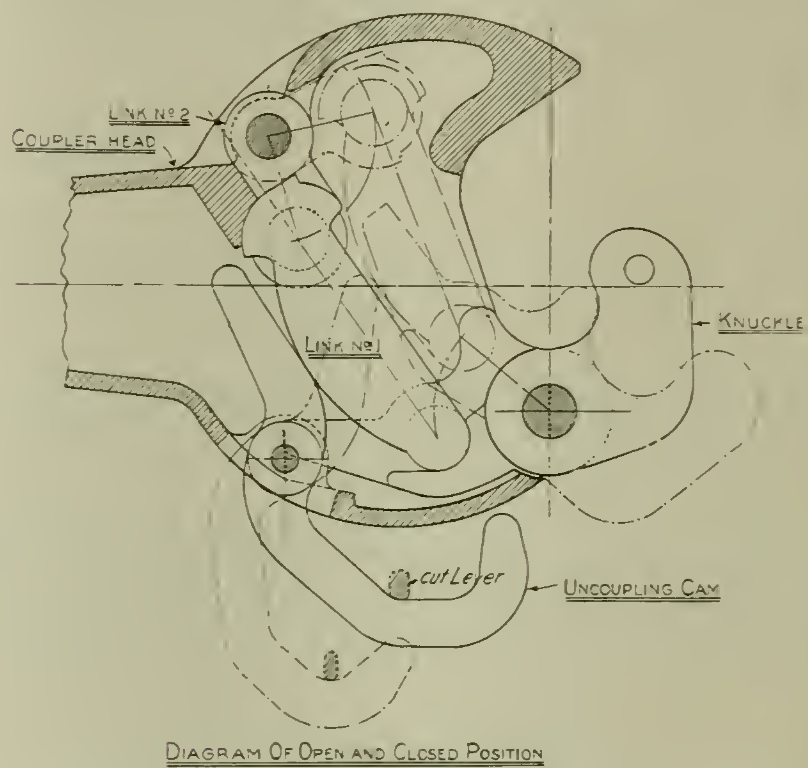


Portable Step Ladder for Bins.

accident is eliminated by the use of this ladder. The old method of using a common ladder or climbing up on the bins was somewhat hazardous. In order that the man may move from one bin to another, all he has to do is to push himself and ladder along the bins. Of course this cannot be done on very rough floors. The ladder is built of pine and is made to be very durable. In the illustration, at A, is shown the method of securing the wheels to the axle; the other details are self-explanatory.

A NOVEL COUPLER

The diagram which forms our illustration is a new design, got out by Mr. Sable, of Denver, Colo., in



Form of Coupler Intended to Permit Uncoupling Under Strain.

which the endeavor has been made to give the "Safety First" feature prominence. In the diagram the knuckle, link No. 1 and link No. 2, are so connected as to form a toggle arrangement when in closed position. Link No. 1 presses solidly against the wall of the coupler, and is of sufficient section to resist any strain on the knuckle which might arise in fair usage. All of the links are pivoted so as to insure their retaining their proper positions. The knuckle may be set by the lever, thus making it unnecessary for trainmen to go between the cars. It is also claimed that uncoupling may be accomplished while under strain, making it unnecessary for the enginemen to "slack off." This means a big saving in time. The uncoupling cam is arranged to exert its greatest force at the beginning of the operation of uncoupling.

During the past few years there has been a steady increase in the activity of cities in an effort to improve conditions relative to smoke. Steps have been taken during recent years in forwarding the work of preventing smoke. Conventions of this association are important factors in the distribution of information as to the latest developments or practices in smoke prevention and the high-water mark attainable when proper and reasonable care has been exercised. City authorities at such meetings exchange ideas as to the efficiency of different methods. Much information can be gained by reading reports and other printed matter on the subject of smoke prevention, but information of this character does not compare with the results to be had from personal conversations with the men actually engaged in the active work in different cities.

AIR BRAKE SYMBOLS AND DETAILS

As some little mystery may surround the various schedules and the symbol letters of the Westinghouse Air Brake Co. equipments, we submit for the benefit of our readers enlightennig information on that company's standard steam road equipments as follows:

1. No. 6 ET. (Engine and tender). Equipment for locomotive without truck brake. Standard for all classes of service.

2. A-1. Old standard equipment for a locomotive without truck or tender brake. Now superseded by the No. 6 ET equipment.

3. AD. Old standard equipment for a locomotive including truck, but without tender brake. Now superseded by the No. 6 ET equipment.

4. AG. Old standard equipment for a locomotive, including truck brake and apparatus for high and low pressures, but without tender brake. Now superseded by the No. 6 ET equipment.

5. D. Standard locomotive truck brake for locomotive already provided with No. 6 ET equipment.

6. U. Double pressure control. Additional apparatus required to equip an engine and tender already provided with old standard AD engine and FL tender equipment, with double pressure control. Now superseded by the No. 6 ET equipment.

7. SWA. Additional apparatus required to equip with straight air an engine already provided with A-1 or AD engine equipments. Now superseded by the No. 6 ET equipment.

8. SWB. Additional apparatus required to equip with straight air a tender already provided with schedule FL, HK, or PK. Now superseded by the No. 6 ET equipment.

9. PK. Automatic brake for passenger tenders, furnished only with old standard A-1, AD or AG engine equipment. Now superseded by No. 6 ET equipment.

10. FL. Automatic brake for freight or switch engine tenders, furnished only with old standard A-1, AD or AG engine equipments. Now superseded with No. 6 ET equipment.

11. PM. Standard quick action automatic brake for passenger, baggage, mail or express cars.

12. LN. Standard, improved, automatic, quick-action, quick-service, graduated-release, quick-recharge, high emergency pressure brake for passenger, baggage, mail or express cars.

13. PC. Passenger brake for heavy passenger, baggage, mail or express cars.

14. J. Air signal device for locomotive having A-1, AD, or AG equipment.

15. L. Air signal device for locomotive having ET equipment.

16. K. Air signal device for passenger, baggage, mail or express car.

17. KC. Standard automatic, quick-action, quick service, uniform release, uniform recharge brake (combined brake cylinder and auxiliary reservoir) for freight cars.

18. KD. Standard automatic, quick-action, quick-service, uniform release, uniform recharge brake (detached brake cylinder and auxiliary reservoir) for freight cars.

19. HC. Old standard automatic, quick-action brake (combined brake cylinder and auxiliary reservoir) for freight cars.

20. HD. Old standard automatic, quick-action brake (detached brake cylinder and auxiliary reservoir) for freight cars.

21. KD-2. Twin cylinder type, standard automatic, quick-action, quick-service, uniform release, uniform recharge, brake equipment (brake cylinders and auxiliary reservoirs detached) for freight cars.

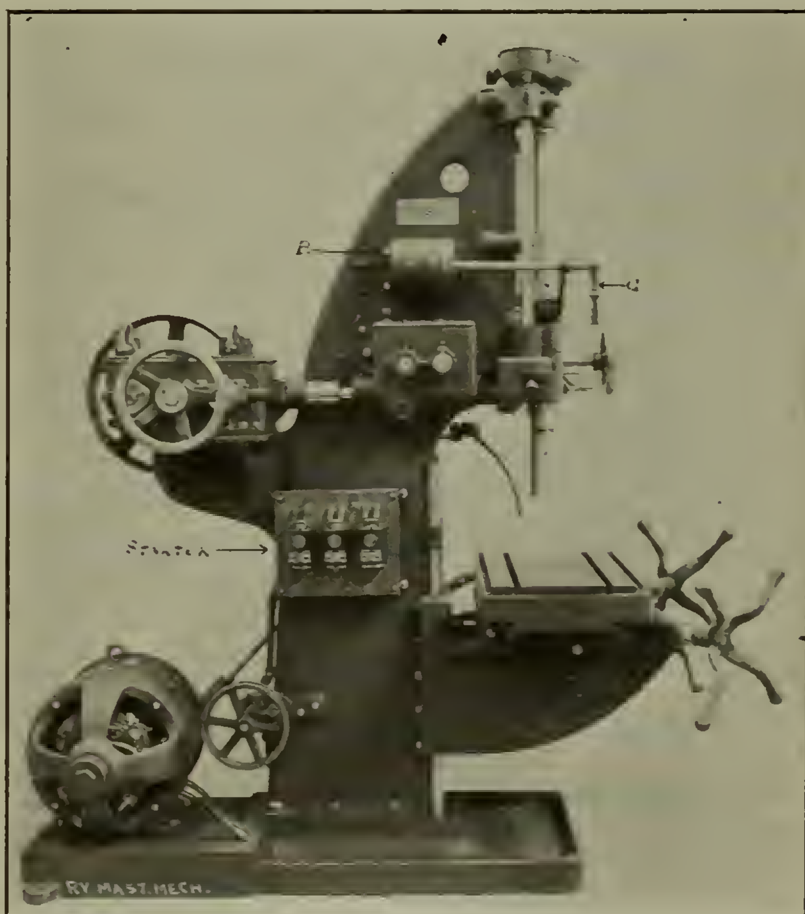
22. HD-2. Twin cylinder type, old standard automatic, quick-action brake equipment (brake cylinders and auxiliary reservoirs detached) for freight cars.

23. KCE. Empty and load brake (brake cylinder and four-compartment reservoir combined) for freight cars.

24. KDE. Empty and load brake equipment (brake cylinder and four-compartment reservoir detached) for freight cars.

MOTOR-DRIVE ON COLBURN DRILL PRESS

An interesting example of adjustable speed motor drive combined with automatic starting control is shown in our illustration. The machine is a Colburn D-1 heavy duty drill press with compound table. Its drilling capacity is 2 ins. in solid steel with high speed drills. The drill press is driven by a 5 horse-power, 450 to 1,800 revolutions per minute, and Reliance adjustable speed motor of the armature shifting design is used. Changes in the motor speeds are obtained by turning the hand wheel, which has been placed conveniently for the operator. The motor runs at any speed within its range so that it is always possible to adjust the motor speed accurately to suit any combination of drill size, feed, and speed.



Motor drive on Colburn Drill Press.

The starting and stopping of the motor are controlled by the E. C. & M. automatic starter through the drum switch at B. This switch has forward, reverse, drift and brake points. When the switch is thrown to the brake position the motor and drill are automatically brought to a quick stop. The handle C of the drum switch is also provided with a special extension so that it is handy for the operator at the front of the machine.

The Illinois Oil Co. of Rock Island contemplates purchasing 20 5,000 gal. tank cars.

Personal Items for Railroad Men

H. S. Hills has recently been appointed master mechanic of the Eastern Kentucky division of the Louisville & Nashville.

J. E. O'Brien, recently appointed Mech. Supt. of the Mo. Pacific Ry., with headquarters at St. Louis, succeeds at that point R. A. Turnball, resigned.

W. C. Smith recently appointed Asst. Mech. Supt. of the Missouri Pacific Ry., with headquarters at St. Louis, succeeds J. E. O'Brien, appointed Mech. Supt.

R. A. Albright, recently appointed master mechanic of the Eastern division of the Texas & Pacific Railway, at Marshall, Texas, succeeds J. J. Carey, transferred.

J. H. Mahoney, recently appointed foreman of the car department of the Cincinnati division of the Erie R. R., at Marion, Ohio, succeeds W. W. Warner, transferred.

E. J. Harris has been appointed acting mechanical superintendent of the second district of the Chicago, Rock Island & Pacific at Topeka, Kansas, succeeding G. W. Lilie.

W. H. Owens, recently appointed mechanical member of the valuation department of the Southern Railway, was until that appointment master mechanic at South Richmond, Va.

C. D. Perry, recently appointed road foreman of engines on the Delaware & Hudson, at Oneonta, N. Y., succeeded O. E. Ackart, and until this appointment was assistant to Mr. Ackart.

P. Linthicum has been appointed acting aster mechanic of the Missouri division of the Chicago, Rock Island & Pacific Railway, with office at Trenton, Mo., succeeding Mr. E. J. Harris.

W. E. Steen, recently appointed storekeeper of the Baltimore & Ohio Southwestern R. R., at Chillicothe, Ohio, was until recently storekeeper on the Cincinnati, Hamilton & Dayton R. R., at Lima, Ohio.

W. W. Warner, recently appointed general foreman of the steel car repair shops of the Erie R. R., at Cleveland, Ohio, was until his appointment general foreman of the Erie R. R. car repair shops at Marion, Ohio.

G. C. Harpke, recently appointed division storekeeper of the Lake Superior division of the Northern Pacific Railway, at Duluth, Minn., succeeds there W. L. Peabody, transferred to the St. Paul division, at St. Paul, Minn.

Harry Webster Gillette, recently assistant chief dispatcher of the Northern Pacific Railway, at Jamestown, N. D., has been made chief dispatcher, with headquarters at Jamestown, N. D., succeeding J. J. Mulroy, promoted.

Grant W. Lilie, recently appointed master mechanic of the Bingham & Garfield, with headquarters at Magna, Utah, was, until shortly before that appointment, mechanical superintendent of the second district of the Chicago, Rock Island & Pacific at Topeka, Kansas.

Paul Willis, recently appointed assistant air brake instructor on the second and third districts of the Texas & Pacific, in charge of instruction car 1801, succeeding R. C. Earlywine, transferred to the first district as air brake instructor in charge of instruction car 1800.

H. U. Mudge, until recently co-receiver of the Chicago, Rock Island & Pacific, with Jacob M. Dickinson has resigned as receiver. Mr. Mudge will continue in full charge of all matters pertaining to the operation of the property, and will hold the title of chief executive officer for the receiver.

L. B. Jones, recently appointed general foreman in charge of the mechanical department of the Macon, Dublin & Savanna, at Macon, Ga., has charge of the work recently directed by W. B. Combs, who has recently resigned as master mechanic at that point to enter the service of the government.

D. I. Clough, master mechanic of the Oregon Electric & United Railways, at Portland, Ore., has had his jurisdiction extended to include the Spokane & Inland Empire, with headquarters at Spokane, Wash., owing to the resignation of A. J. Mayham, who formerly held the position of railway master mechanic of the Spokane & Inland Empire.

W. E. Nelson, recently appointed train master of the New York Central & Hudson River R. R., at Lyons, N. Y., entered the service of that road as telegraph operator when he was a boy, and in 1905 was appointed chief night dispatcher and in 1910 became assistant train master, which position he held until the announcement of his recent appointment.

Judge Carpenter has, it is reported, authorized the receivers for the Rock Island to purchase 4,000 steel-frame box cars. The total cost, it is said, will be $3,409,540, of which about $3,000,000 to be provided by car trusts maturing semi-annually in series, and the remainder to be paid in cash. These are, it is thought, probably the certificates authorized last June.

J. W. Foizey, recently appointed master mechanic of the Chesapeake & Ohio Railway, at Newport News, Va., entered the service of that road as machinist at Richmond in 1875. In 1889 he was promoted to the position of gang foreman. In 1891 Mr. Foizey was transferred to Clifton Forge as general foreman, and in 1902 returned to Newport News in that position, where he remained until the announcement of his recent promotion.

C. D. Perry, recently appointed road foreman of engines on the Susquehanna division of the Delaware & Hudson, entered the service of that road in 1902 as fireman; was promoted to engineman in 1905, and in 1914 was made assistant road foreman of engines, which position he held until the announcement of his recent appointment, where he succeeds O E. Ackart, transferred.

W. T. Montague recently appointed Asst. M. M. of the New York Div. of the Penn. R. R., with headquarters at Jersey City, N. J., entered the employ of the Penn. R. R. at Altoona, as special apprentice in 1907 and was appointed motive power inspector at Harrisburg in 1911. Mr. Montague was shortly transferred in the same capacity to Pittsburgh and in 1913 appointed enginehouse foreman at Brownsville, Pa., which position he held until the announcement of his recent change.

D. L. McKee, recently appointed master carpenter of the Pittsburgh & Lake Erie R. R., at McKee's Rocks, Pa., has been in the employ of that road throughout is existance. Mr. McKee was employed as carpenter by the bridge contractors during the construction work, and on the completion of the railroad entered their employ as a carpenter. In 1880 he was appointed gang foreman of carpenters, and held this position through a change of

administration in 1889, and was later appointed general foreman, which position he held until, at the death of G. H. Soles, superintendent of bridges and buildings, he was advanced to his present position.

J. K. Millholland, recently appointed assistant master mechanic for the Baltimore & Ohio at Keyser, W. Va., entered the service of the G. C. & C. R. R. in 1894, and spent fifteen years in learning the trade of machinist and in working as a machinist. In 1909 he entered the employ of the Baltimore & Ohio as machinist at Keyser, and later the same year was appointed night round-house foreman. In 1912 he was made day engine-house foreman at the same point, and in 1913 was made general foreman at Grafton, W. Va., which position he held until his recent appointment. Mr. Millholland succeeds at Keyser T. F. Perkinson, recently promoted to master mechanic at Grafton, W. Va.

J. H. Fullerton, supervisor of bridges and buildings on the Boston & Maine R. R., at Woodsville, N. H., entered the employ of the Cornwall R. R. in 1873 as a carpenter, and in 1882 was made a foreman when that road consolidated with the Boston, Cornwall & Montreal and took the name of the Cornwall & Montreal R. R. Later Mr. Fullerton was appointed general foreman, and in 1898 was appointed supervisor of bridges and buildings of the White Mountain division of the Boston & Maine. In 1911, owing to a rearrangement of divisions, he again took the position of foreman, which he held until the recent announcement of his return to the position of supervisor of bridges and buildings.

W. W. Smock, recently appointed master mechanic of the Pittsburgh division of the Baltimore & Ohio R. R., entered the service of the Baltimore & Ohio as machinist at Mount Claire in 1908. About a year later he was appointed locomotive inspector for the American Locomotive Works, at Richmond, Va., and in 1910 went to Empire Slip, Chicago, to inspect locomotive cranes. Later Mr. Smock was with the Baldwin Locomotive Works for about two years, and then was appointed general foreman for the Baltimore & Ohio, East Side, Philadelphia, and shortly after was made inspector of locomotives for the Baltimore & Ohio at the Baldwin Locomotive Works. Mr. Smock was then transferred to Glenwood as chief round-house foreman, which position he held until the announcement of his recent appointment.

Ralph L. Chandler, recently appointed district master car builder on the New York Central R. R., at East Buffalo, N. Y., was born in 1875 at Milford, N. Y., and entered the service of the New York Central in 1891 as machinist's apprentice. In 1894 he joined the force of the Pullman Co. at Buffalo, and in 1896 entered the service of the American Car & Foundry Co. Mr. Chandled returned to the service of the New York Central as car repairer in 1897, and in 1898 was appointed foreman, becoming assistant general foreman in 1900. In 1903 he was made piece-work foreman on the Western division, and in 1911 he was appointed superintendent of shops at East Buffalo. Later in that year he was appointed division general foreman of the Pennsylvania division, and in 1912 he was made supervisor of piece work of the car and locomotive departments, which position he held until the announcement of his recent appointment.

John McDonough, recently appointed assistant superintendent of the Mount Claire shops of the Baltimore & Ohio R. R., entered the railroad service in 1904 as blacksmith apprentice in the Big Four shops at Urbana, Ill. While attending the University of Illinois during the years of 1905 and 1908, inclusive, Mr. McDonough worked as a helper in the Big Four boiler and blacksmith shops during the summer months. In 1908 he became a special apprentice at Beach Grove, Ind., and in 1910, was made piece-work inspector at that point, after which he was gang foreman and later general piece-work inspector. In 1913 Mr. McDonough entered the service of the Baltimore & Ohio at Mount Claire as assistant to the superintendent of shops in charge of piece work. He was later made supervisor of locomotive piece work for the system and general foreman, which he held until the announcement of his recent appointment.

W. O. Thompson, recently appointed superintendent of rolling stock of the New York Central Lines West of Buffalo, entered railroad service in 1880 as a clerk on the Ft. Wayne, Jackson & Saginaw R. R., and in 1884 was appointed locomotive engineman. In 1890 he was appointed traveling engineer of the Lake Shore & Michigan Southern, and in 1893 was appointed dispatcher of that road. In 1901 Mr. Thompson was appointed general locomotive inspector of the New York Central, and in 1902 was made superintendent of motive power of the Rome, Waterton & Ogdensburg R. R. In 1907 he was appointed district master car builder of the New York Central at Buffalo, which he held until the announcement of his recent appointment. The office of superintendent of rolling stock of the lines west of Buffalo was created by separation from the motive power department, Mr. McBaine continuing as superintendent of motive power.

W. H. Haley, recently appointed superintendent of car service of the Missouri Pacific, with headquarters in the Railway Exchange Building, St. Louis, entered the railroad service as a messenger boy for the Terminal Association of St. Louis in 1888, and held consecutively the positions of yard clerk and car accountant until, in 1901, he was appointed general yard clerk of the Missouri Pacific at St. Louis. In 1904 his jurisdiction was increased to include the St. Louis, Iron Mountain & Southern. In 1905 Mr. Haley was appointed clerk of the St. Louis Terminal division for the same roads, and in 1907 was made freight car distributor. In May, 1912, he was made superintendent of the American Refrigerator Transit Co., at St. Louis, which position he held until the announcement of his recent appointment as superintendent of car service, as mentioned. Mr. Haley succeeds in his new work W. I. Steine, who has become superintendent of the American Refrigerator Transit Co.

Jos. E. Gould, recently appointed master mechanic of the Charlotte, Harbor & Northern Railway, at Arcadia, Fla., entered the service of the Pittsburgh, Cincinnati & St. Louis Railway in 1881 as an apprentice in their shops at Dennison, Ohio. After completing his apprenticeship, he took special courses in the Ohio State University for three years, and re-entered the service of the P., C. & St. L. in the motive power drafting room. In 1894 he was appointed assistant to the master mechanic in the Dennison shops, and in 1898 was appointed general foreman of the Columbia shops of the Toledo & Ohio Central. In 1900 he was appointed master mechanic at Chattanooga, Tenn., for the Cincinnati, New Orleans & Texas Pacific, and in 1903 was made master mechanic of the Northern division of the Cincinnati, Hamilton & Dayton R. R. For six months in 1905 he was appointed master mechanic of the Columbia and Nebraska divisions of the Chicago, Rock Island & Pacific, and the same year was appointed superintendent of motive power of the Norfolk & Southern, which position he held until entering the service of the Charlotte Harbor & Northern Railway, where he succeeds W. H. Amis, who is now connected with the Central of Georgia, at Columbia, Ga.

SEVENTEENTH ANNUAL CONVENTION OF THE

Chief Interchange Inspectors and Car Foremen's Association of America

The seventeenth annual convention of the Chief Interchange Car Inspectors and Car Foremen's Association of America was called to order by its president, Mr. F. H. Hanson, at Richmond, Virginia, promptly at 10 o'clock on the morning of September 14, 1915.

The Rev. J. K. Sherer, pastor of the First English Lutheran Church of Richmond, opened the meeting with prayer.

Mr. Boutet: It has been the custom of this association since its organization to furnish the members and their ladies each with a badge which entitles them to recognition for the different amusements, and it is only fitting and proper, as we have done in former years, to decorate our president with a gold badge. I now take pleasure in adorning you with this badge of office, trusting that you will wear it to the credit of this association and yourself. I also ask that the ladies extend to the new president the same courtesies that they have extended to me during the years that I was at the head. I want you all to know that Mr. Hanson is just as modest a man as I have been.

President Hanson: I wish to say in behalf of Brother Boutet and the members of this association that I certainly appreciate this gift very much and I thank each and every one of you for it. I trust I may have the pleasure of wearing it and meeting with you for many years to come and that I may always look back with pride on my administration which brought me this beautiful jewel and I hope I will throw no blemish on the badge when wearing it in the future.

There have been several things to which I have given a good deal of thought, with a view to broadening this association. I have talked with a number of railroad officials along this line and they felt that our association had reached the point where we should broaden out. These matters will be taken up in their proper course in the convention. Some of these things I hope to see manure and I trust they will be of such a character and result in such good that I can look back to them and this jewel for which I thank you.

I now have the pleasure of introducing to you Hon. John Pollard, attorney general of Virginia, who has come as a representative of Governor Stuart to welcome us.

ADDRESS OF MR. POLLARD.

Mr. Chairman, Ladies and Gentlemen:

I am requested by the Governor to express his regret at not being able to be present here this morning to welcome you to our state. I shall not attempt to take the place of the Governor on his occasion for I am restrained by my memory of Æsop's noted fable of the frog and the ox. You remember the frog tried to swell himself up to be as big as the ox and he succeeded only in bursting.

I came here this morning expecting to welcome the inspectors and the foremen and much to my surprise I see before me a lot of the inspectors and foremen's bosses. This is truly a ladies' day. We find the ladies taking possession of everything. The question as to whether women are as smart as men is no longer a serious one. All of the men now are willing to present the palm to the ladies. I heard the other day one of the best and most conclusive arguments in support of the statement that women are in every way smarter than the men. A man said: "Why, of course the ladies are smarter than we are because if they were not smarter than we are, how could they get us to marry them." This is somewhat inconsistent with the old saying that God made women beautiful so the men would love them, and then made the women silly so they would love the men.

And so, my friends, it is very hard for me to have prepared a speech of welcome for the inspectors and to have to talk to the ladies. In fact I believe that when I am addressing the ladies I would rather address one at a time.

I suppose that all of you who have ever been to Virginia before have discovered the fact that we are very proud of ourselves. Virginians are noted the world over for thinking more of themselves than anybody else thinks of them, but I want to say a word in defense of our pride. I think we have a right to be proud of ourselves because we are the only people on earth who can trace ourselves back to people that are better than we are. Now think for a moment if you could trace yourselves back to Jefferson, Adams, Washington—not Adams; he is a Massachusetts man, but Henry and Marshal and Lee, and all those great men, wouldn't you be proud of yourselves. We feel sorry for people who were not born in Virginia, but we are big-hearted people and we are disposed to forgive you, we are not disposed to hold it against you because you could not help it. I once heard of a young lady who was reproved very strongly by her mother for asking a gentleman whether he was born in Virginia. As soon as the mother could get the daughter aside she said: "Never again ask a gentleman whether he was born in Virginia, because if the gentleman were born in Virginia, he would tell you so, and if he were not born in Virginia, it is impolite to embarrass him by asking him the question."

The Mayor is here to tell you of the glories of our great capital city and I would be infringing on his prerogative to tell you about the special points of interest in our great city, but I want, on behalf of the Governor, to say to you that he regrets so much that he could not be here to tell you how glad he is to welcome you to our soil, and to say to you that he hopes this visit to Virginia will forever be a green spot in your memory.

President Hanson: It gives me great pleasure to introduce to you his Honor George Ainslie, mayor of the city of Richmond.

ADDRESS OF MAYOR AINSLIE.

Mr. Chairman, Ladies and Gentlemen:

I want first to take advantage of the opportunity that I have to congratulate this association upon the promptness of its assembly. I have been in the mayor's chair for three years and have met a great many conventions. I never saw one assembled on time before. I have been kept waiting as long as an hour for the assembly of meetings and during all of these times I have bad a great deal of opportunity for reflection upon the point: Why is it when people have come as far as some of those people have to come to the city of Richmond to a convention that they wont meet at the time the convention has arranged its meeing hour? I would generally have a programme of each one of these conventions and finally the thought dawned on me that there was an explanation for it and a very plausible one. Whether it is the true explanation or not I do not know, hut at any rate this idea occurred to me. Having seen so many of them and having read so many of their programmes. I long ago became convinced that there are no people in the world like the American people with a capacity to sit down in chairs and let other people talk at them. It occurred to me that maybe some of these conventions, knowing what was in store for them after they started, I had a right natural disinclination to take the plunge, and I have often thought that some of them before the convention commenced must have gotten into the state similar to the negro boy who was calling on bis girl one evening. This negro boy was a slight, slim chap weighing about 98 or 100 pounds. His girl was a bit heavier than he was and weighed 230. One evening when he was calling about nine o'clock the object of his affections settled down on his knees and then began the billing and cooing of the evening. Toward midnight she snuggled up a bit closer to him and whispered: "Sweetheart is you tired?" He said: "Tired, my God Almighty, I have been paralzed since the clock struck half past nine."

The Attorney General was acting in the place of the Governor, but he fervently hopes that if you come to Richmond in the next few years he will be acting in his own behalf. He has told you about these Virginians and their right to their feeling of being somewhat different from other folks, because they trace themselves back to Washington, Henry and Madison and all those great men. Why these people, in the real feeling, when they come to talk about tracing themselves back, are newcomers besides the people from whom the Virginians really trace themselves, according to the Scriptures as pronounced by an old negro preacher in the State of Virginia some years ago. This old man found that there was a disposition on the part of some of his flock to stray from the straight and narrow path and he had tried everything he knew of to get the wandering sheep. So he went aside and thought he would appeal to their pride, and, opening the Bible, he told them there were obligations resting on them that he found laid down in the Scriptures itself that they could not ignore, and that they were going to be held responsible on the Day of Judgment if they did not conduct themselves in accordance with who they was. "Now," he says, "according to the Bible, as I understand it, there are four chosen tribes of the Lord, and it don't matter about anybody else; them four tribes is sure of salvation on the final day and the reason you don't got to look how you is going is because you belong to one of them four tribes. Them four tribes is the Huguenots, Hottentots, Abyssinians and Virginians."

There were days, not so very long ago—they are still within the memory of most of us—when the railroads seemed to regard the people of the United States as easy fruit. They treated them much as they wanted to and the people stood it for a long time. And when they began to rise, as people usually do when they rise in a body, they arose to an awful height and the impression got abroad among the railroads that the people thought that their principal spirit, from then on, was going to be railroad baiting, because when they undertook to bring the railroads to what they considered a fair and just attitude toward the people they put some very severe restrictions and regulations on them. After time for reflection an adjustment came, and I believe it is true, fair and proper to say that the people and the railroads understand each other better now than they ever did before in their lives. The people understand that they cannot do to the railroads those things which will seriously affect their efficiency, and the railroads understand that they must deal fairly and justly and honestly with the people.

It is a fine thing to see that the apparent antagonism, one way or the other, that went through the years, and nobody knew where it would stop—it is a fine thing to see that there is a real understanding that the people who do not work for the railroads understand that the people who do are folks, just like themselves, and are not a set of thieves that are trying to rob them all the time. And the people who work for the railroads understand that the people who do not are not a set of suckers that they can make monkeys of for the rest of their lives. I believe, having come to that very simple understanding, that it means forever in America a better, more equitable, more friendly relation between the people and their representatives and the railroads, because we all, when we think of it, must know that the railroads are the same thing to the country that the arteries are to the body, and that when the railroads begin to fail the country suffers exactly as the body does when the human arteries begin to fail.

Last week we had here a meeting of the Senators of Virginia, a number of members of the Chamber of Commerce and the State officials on the question of the depth of our river, and there was one thing that struck me in that meeting as a hopeful sign, and that was that every mna in it had come to understand that transportation was the life blood of the country. It took us a long time to understand that very simple thing, but we have come to understand it, and I do not believe that there is the remotest possibility of the people in this country ever again treating the transportation companies as mere game, to be hunted and bagged for sheer sport, as they seemed to be doing a very few years back.

In addition to the welcome that has been extended to you by the Attorney General, I merely wish to add one for the City of Richmond. I am not going to do what he suggested that I do. I am not going to talk to you about the glories of Richmond, because as each of us has explained to you what sort of people Virginians are it would not be fair for me to start talking to you about the glories of Richmond. You have other business on your programme that you want to get at. But I will say to you that we welcome you to Richmond with all of our hearts. We appreciate more than we can tell you the compliment that you have paid the City of Richmond in coming here.

I want to extend a particular welcome to the ladies. The former Governor of Virginia, whom I have often heard welcome associations of a national character, used to say that he believed that if the Federal army in attacking Richmond had done what these national conventions are now doing—brought along with them in their ranks their beautiful and attractive ladies—that not only there would have been no resistance upon the part of the people of Virginia, but that the men would have welcomed them with open arms.

I unite with the Attorney General in wishing for this meeting all that mixture of pleasure and profit that will make it for you so memorable an occasion that, at the first opportunity you have, we shall have the pleasure again of welcoming tbis association to Richmond.

I thank you very much for your attention.

President Hanson: I am going to ask Brother O'Donnell, from Buffalo, to thank the reverend gentleman for his opening prayer and to reply to the honorable speakers. The majority of our members know Mr. O'Donnell, but I have the pleasure of introducing him to the new members.

ADDRESS OF MR. O'DONNELL.

Mr. President, Ladies and Members of the Association, Honored Officials of Virginia and the Entertainment Committee:

We of the North have oftentimes heard in our school days of the hospitality of the South. On my part, it is the first time in my life that I have set foot in the State of Virginia. My first impression was that it took a

great deal of energy to keep up that spirit they call good feeling on account of the weather, but at this time, after hearing the excellent remarks of the Rev. Dr. Scherer, the representative of His Excellency, Governor Stuart, and His Honor, the Mayor, I, for one, want to say that I am glad I am in Virginia.

We, over in the Empire State of New York, usually are greeted with "How do you do?" and then they get out. But the remarks we have heard this morning certainly should sink deep in our hearts, remain with us while we are in Richmond and take them home with us and think more of the State of Virginia, whose ancestry has made it one of the most famous States of the United States. Many of our Presidents are Southern, including the President who is now at helm of State in our national capital. I do not think I transgress the feelings of any member or individual if I state here publicly that our good President, Mr. Wilson, has every ounce of energy and support from every individual in the United States at the present time, and in bringing out these sentiments in one of the Southern States, from we Northern people, if you please—there isn't any division of North and South now—it is a great privilege to hear the welcome that has been given us ordinary railroad people this morning by these good gentlemen representing the great Commonwealth, and on behalf of the rank and file of this association, representing our president, officers, ladies and members, I deem it a privilege and honor to thank you, sir, the Rev. Dr. Scherer, for the words of encouragement you have given us in coming here this warm morning to carry us on through this busy life which, we all realize, must have some of the divine feeling as well as the human, especially in these times when we all are struggling for right, justice and peace of home and contentment of country.

To the Honorable the Attorney General of this State, Mr. John Pollard, I deem it a pleasure to extend to him who represents the legal fraternity of this great State our sincerest thanks, and I second the remarks of His Honor, Mayor Ainslie, in saying that some day may he represent the State of Virginia.

To His Honor, Mayor Ainslie, who is in the prime of life, we have nothing but kind words while he is with us here this morning. He has given us an excellent welcome. He represents the true type of the head of the great municipalities of this country, showing a keen interest in the welfare of her people, and may the good Mayor follow up his vocation, and some day may we not hope that we will have another President from Virginia.

The words I speak are the words of those who are looking at you this morning. To the Entertainment Committee I have nothing to say this morning. I may have later. They are a smiling lot of gentlemen. Without them I do not know what we would do.

Now, gentlemen, the thanks of the association, through your president, spoken by me, come from the heart. While we are in your city we shall endeavor to act as we should, but I want to say in closing that our reputation while in Richmond rests entirely with the ladies. Those of us from the North have, in the past few years, more or less become devotees of the late Secretary of State—we like grape juice—so you must look to the ladies to save the reputation of Richmond, and I feel confident that when they go home they will say: "Let us go South for the next convention. We never had such a nice time in our lives."

I am glad we accepted the invitation, and we deeply appreciate the words you have said and sincerely thank the worthy divine for the words he has given us.

ADDRESS OF PRESIDENT F. H. HANSON.

It gives me great pleasure, in opening this, the seventeenth annual meeting of the C. I. C. I. & C. F. Association of America, to extend a word of greeting to the members and their friends here assembled.

Many of you have attended our previous meetings, and your presence today indicates that you have found them either pleasant or profitable. Let us hope that we may all derive both pleasure and profit from this one. The most of us come here because we consider that we and the railroads we represent are benefited by our presence. I have no reason to doubt that their anticipations will be realized, but I want to suggest that we all contribute our share toward the discussions.

The hours of sessions will be from 9 A. M. to 12 noon and from 2 P. M. to 5 P. M. I hope that each one of you will be on hand promptly at the opening and remain throughout the sessions.

The past year has certainly been a very trying one for the management of the railroads, compelling the officials to spend a great deal of their time studying new ways of economizing and reducing expenses without interfering with the quality of the service.

Heavier power has been purchased, with a view of handling a larger number of cars per train and get them over the road in as short a time as possible. This necessarily requires that all cars be in safe condition to be handled in such trains.

Some of the railroads are spending large sums of money equipping cars with steel underframes, friction draft gear, steel ends, etc., which materially assists in avoiding delays enroute and keeps the cars off the repair tracks. There are a large number of cars, however, that are not receiving these betterments and must be given careful attention in the way of inspection in order to know that they can be handled in such trains with safety; also to see that they are not cut out and sent to the repair or transfer track unnecessarily, both of which require good sound judgment on the part of the inspector.

A car passing in interchange at New York should, if in the same condition, pass in interchange at any other point in the country.

There is a general effort on the part of the railroads to reduce delays in the movement of cars. Delays are due to various causes, some of which would not be affected by any action we might take. The matter of inspection and delays to cars in interchange and cars transferred, however, is one over which we have some control, and I believe that the M. C. B. Rules are now so framed that cars can be passed in interchange promptly without working an injustice to anyone.

The transferring of cars should be given careful consideration. While a wonderful improvement has been made in the past year in reducing the number of cars transferred, which, in my opinion, has largely been brought about by a more uniform understanding of the M. C. B. Rules, there is still room for further improvement along these lines.

In recommending changes in the rules, we should be very careful to know that such changes are absolutely necessary and good results will follow. If this is done it will not, in my opinion, be necessary to make changes in the rules oftener than every two years. I note the Arbitration Committee, since October 1, 1914, have prepared answers to about one hundred and fifty questions, thus imposing a very heavy burden on this committee, as it covers one hundred and thirteen pages of the rules and fifty pages of interpretations. I believe we should be more cautious in submitting what, in many cases, may be termed mere trivial questions, thereby reducing the labor of this very busy committee. By having representatives from various associations attend our annual meetings, a great many of these questions could be satisfactorily explained at that time. With this end in view, would it not be advisable to appoint a special committee or make it a part of the executive committee's duties to see to it that representatives from the M. C. B. Association, Arbitration Committee, American Railway Association, Bureau of Explosives and other similar organizations are invited and urged to come to our meetings?

I shall welcome the day when a standard car is adopted by the M. C. B. Association and maintained as such; also when the rules covering combinations of defects—namely, rules 41 and 42, which are supposed to indicate unfair usage—are eliminated from the M. C. B. Rules.

Damage to freight is another important feature to be given consideration. Some railroads have recently appointed committees, known as "loss and damage" committees, who investigate the cause of damage to freight, and their reports show a great many cases due either directly or indirectly to defective equipment.

Reliable figures show $16 paid out for loss and damage to freight for every $1,000 of gross freight revenue. As Car Department employes, we should do our part to reduce these figures. Repairmen should make sure that the work which they have done will not prove defective and allow freight to be damaged, and inspectors should see to it that material in open cars is properly loaded and braced in all cases. The enforcement of the loading rules is now quite generally insisted upon and has resulted in expedited movement of traffic and decreasing claims for loss and damage to lading, yet the railroads in 1914 paid claims amounting to $32,375,617.55, a material proportion of which might have been saved had the shipments been properly packed and secured.

The matter of complying with loading rules is another important feature that should be given careful attention in the way of educating the shippers. It is not the intention of any railroad to impose a hardship on the shippers or to antagonize them in any way, and I believe if representatives from the mechanical department make it a point to call on those who hesitate in complying with the rules and show them the importance and, in a great many cases, the danger involved when the rules are not complied with, we will have but very little trouble along these lines.

The thought of holding the initial line responsible when cars are not loaded in accordance with the rules is gaining ground, and I understand the matter is now in the hands of the American Railway Association with this end in view.

When inspecting cars before being loaded we should know that they are in such condition that no damage will occur to contents on account of defective equipment. Too much emphasis cannot be placed on the importance of maintaining correctly all details of cars which have been fully equipped with safety appliances. I believe we have a pretty good understanding as to the intent of the present law, and when making repairs to cars that have not been equipped, such repairs should be made to comply with U. S. S. A. laws.

Another important feature that should be given careful attention is defective brake beams and parts. A great many cars are now in service with parts worn to such an extent that they are absolutely unsafe. Some railroads are now making a vigorous campaign along these lines, but others are paying absolutely no attention to these conditions. In order to obtain the required results, all roads should go into this matter very thoroughly by giving these parts special inspection as cars pass over repair tracks, using a bar to raise the brake beam in order to properly inspect the heads, hangers and keys. By so doing, you will find a great many of these so badly worn that they are unsafe and should be removed.

A few months ago a vigorous campaign was started by the railroad I am with, and it was felt of such importance that our S. M. P. & R. S., Mr. MacBain, and his assistant, Mr. Chidley, spent a day in one of our important yards looking into these conditions, and they found ninety-five per cent. of our brake beam trouble was in the brake head, brake hanger and brake shoes; the loop hanger brake head being one of the worse. As a result of this inspection, special men have been put on in all of our large yards to make special examination of trucks in every instance when this could be done, not only on repair tracks, but in yards as well. The result is that we have a miscellaneous assortment of brake heads, brake hangers, brake pins, etc., amounting to between 60 and 90 tons, removed at three of the prominent yards on the New York Central west of Buffalo. I wish to appeal to every member of this association that on your return home this matter be gone into just as far as your authority will permit, and I know you will be surprised at the conditions found. It should then be taken up with your superiors to have the condition remedied.

This association has a reputation, and I hope it will go on and prosper in the future as it has in the past; conclusions made by it have been looked upon with favor and some adopted by the M. C. B. Association.

Past President Crawford of that association, in his address at the last M. C. B. Convention at Atlantic City, spoke very forcibly on establishing closer relations with associations such as our.

Mr. Hennessey, chairman of the Arbitration Committee; Mr. Brazier, superintendent rolling stock of the New York Central; Mr. Coleman, superintendent car department of the Grand Trunk, and Mr. W. F. Schaff, superintendent of the New York Central, call attention to this fact in letters received from them. These letters will be read later.

The editor of the Railway Master Mechanic and editor of the Railway Age Gazette recently had articles in those magazines dealing with the results obtained by closer relations between the various organizations. Such expressions as these lead me to believe that the M. C. B. Association recognize us as a very valuable asset to their organization, and I hope that more of the members of that association will be able to meet with us in the future, and that at least one member of the Arbitration Committee can be prevailed upon to do so.

A few years ago it was felt by some that the M. C. B. Rules could not be lived up to or enforced, at least at some point; but I am pleased to state that these opinions do not now exist and that it is the unanimous opinion that these rules can be lived up to in all parts of the country without penalizing any line.

Since our last convention four of our members—F. W. Chaffe and G. M. Bunting, S. Mann and F. X. Shuler—have been taken from us by death and their familiar faces will be greatly missed. Special committees will be appointed to frame appropriate resolutions upon the death of these former members.

Exhibits of railway appliances arranged for our inspection have been prepared by our Railway Supply friends, and in order to acknowledge our appreciation of the time, effort and expense incident to their preparation I would urge that all, including the ladies, take advantage of the opportunity to become familiar with the various devices.

In conclusion, I desire to express my thanks to the officers of the association, also to the members of the entertainment committee and the friends who have contributed towards our entertainment, and hope for the new president the same loyal support and hearty good will of the members as I have had during my term of service.

The following letters of greeting were read:

August 3, 1915.

Mr. F. H. Hanson, President C. I. C. I. & C. F. A. of America,
Collinwood, Ohio

Dear Sir:

I beg to acknowledge receipt of your very kind personal invitation of July 31st, asking me to attend the next convention of your association, which will be held at Richmond, Va., September 14 to 16, inclusive.

While I would like very much to attend your session, I am afraid that the pressure of business here will prevent my attendance. However, should I find that I will be able to attend I will be very glad to do so.

I have been very much interested in your association, and particularly in your efforts to have a more universal understanding of the Master Car Builders' Rules of Interchange. I believe that your meetings with the Arbitration Committee of the Master Car Builders' Association have been productive of very good results, in that they have undoubtedly made a better and more universal understanding of the M. C. B. Rules. I hope for a continuation of such meetings.

There is one thing that I would like to have you present to your association, and that is the necessity for all of the inspectors to make personal and painstaking joint inspections. As you have doubtless observed, the M. C. B. Rules have been amended from time to time to give the joint inspections more weight and consideration. It is upon these joint inspections that great amounts of money are expended. It would seem to me to be very pertinent to call to the attention of all of your members the responsibility and trust that has been placed on these joint inspectors, and that they should be ever mindful of their duty, and to take no advantage of this trust.

It has been my painful experience within the last year to have occasion to take up two cases where joint inspections had been made, and where, on account of the construction and age of the cars, we were very much in doubt as to the accuracy of the statements presented. Upon personal inspection of these cases, we found the joint inspections were at variance with the facts, which showed that the joint inspections were either made very carelessly or by only one man.

There is nothing more that I can think of at the present time that would be of interest to your association, and I trust that I will have the opportunity to be with you during your sessions at Richmond, Va., in September. As stated before, I am very much afraid that I will be unable to be with you.

With kindest personal regards and with the best wishes for the success of your deliberations, I beg to remain,

Yours very truly,

J. J. Hennessey, Master Car Builder.

August 31, 1915.

Mr. F. H. Hanson, President C. I. C. I. & C. F. A. of America,
Collinwood, Ohio.

Dear Sir:

I have your favor of the 30th inst., inviting me to attend the convention of your association at Richmond in September, and it is with regret I say it will be impossible to attend this year. I know that our line will be ably represented, as I note with much pleasure that you are this year the president, and on the executive committee there are two members of the New York Cntral Lines.

Mr. William R. McMunn, our chief inspector, will be present at your convention. As you no doubt are aware, Mr. McMunn meets with the Arbitration Committee, account of my being a member of that body, and he can, therefore, give your convention much valuable advice on the M. C. B. Rules.

I desire to call your attention to President D. F. Crawford's address before the Master Car Builders' Convention this year, at Atlantic City, and I quote the following from his address:

"Bearing in mind the increasing complexity of the many points included in the construction, maintenance and interchange of cars, it would seem imperative that the members of this association observe more closely the proceedings of such voluntary bodies as the Air Brake Association, Car Foremen's Association, Interchange Inspectors' Association and similar associations, in which, from time to time, are discussed questions regarding cars and their use, to the end that information promulgated by them may not be regarded as authoritative in so far as it may conflict in any degree with a strict interpretation of the Master Car Builders' Rules."

There is in this suggestions no intent to deprecate or criticize ehe work of these industrious, capable and energetic associations, but it is highly desirable to avoid conflicting views, as well as to conserve the full benefit of the time and labor of these associations for the railways which employ their representatives. Would it not be advisable for one of the existing committees, or a special committee of this association, to review their proceedings and advise if it will not be possible to make their work more co-operative and consequently more valuable to all.

I thoroughly agree with Mr. Crawford's views. Your association has been of great help to the Arbitration Committee in connection with interpretation of rules, and I feel that the close relations which have existed between your association and the Arbitration Committee have been of much benefit to the railroads at large. The members of this association handle the most difficult part of railroading, the interchange of equipment, and it has been through the members of your association and the interpretation of the M. C. B. Rules by the Arbitration Committee that the interchange of cars without difficulty and delay has been accomplished. When we stop to consider the great number of cars interchanged throughout the country, based on the M. C. B. Rules, interpreted and put into execution by the inspectors of the country, it certainly shows that so far as the M. C. B. Association is concerned that it can make laws and execute them successfully, which no other form of government in this country, or any other country, can do. This certainly is a compliment to the M. C. B. Association and to you men who carry out the rules interchange.

I trust that you will have an interesting convention and that your discussions will be of benefit to you, one and all. I also trust that your association will give an expression of opinion relative to the advisability of making as few changes as possible in our rules during the next year or two. I personally believe the rules as printed, with their interpretations, are clear and easily put into operation. I am aware that there are some who are forever looking for technicality and misconstruing interpretations, and I believe an expression from a body of men such as you will have much weight. With kind personal regards, I am,

Yours very truly,

F. W. Brazier.

Cleveland, September 4, 1915.

Mr. F. H. Hanson, Asst. Master Car Builder,
New York Central Railroad,
Collinwood, Ohio.

My dear Mr. Hanson:

Please extend to the members of your association my best wishes for an enjoyable and profitable convention. Yours very truly, D. R. MacBain.

Montreal, August 18, 1915.

Mr. F. H. Hanson, Master Car Builder,
L. S. & M. S. R. Rd, Cleveland, Ohio.

Dear Sir:

I wish to thank you for your personal letter of 31st ulto., file JSK, and kind invitation to attend convention of the C. I. C. & C. F. A. of A. at Richmond, Va., on September 14, 15 and 16.

I regret very much that it is impossible for me to attend convention on either of these dates, but I assure you that we are heartily in accord with your association, and am sure the railways appreciate the work and good results they receive from your conventions each year, giving car foremen and inspectors opportunity to interchange ideas, and on account of conditions constantly changing from year to year and federal laws requiring standardizing of safety appliances, etc., together with different State laws exacting uniformity of safety appliances and railway equipment, makes it more necessary for men who are in direct touch with the inspection of equipment and maintenance to have annual gatherings where they can discuss and exchange ideas regarding federal laws and M. C. B. Rules.

Valuable information is obtained from men attending these conventions on account of open discussion of various methods and practices for inspection and repairs to equipment. Men become more valuable, and have a greater interest in their work, due to a broader conception of what is required and the possibilities of the future.

Wishing you every success at your convention and an enjoyable time, and again thanking you for your kind remembrance, I am,

Yours very truly,

J. Coleman, Supt. Car Dept.

Cleveland, O., September 9, 1915.

Mr. F. H. Hanson,
Ass't Master Car Builder.

Dear Sir:

Your request in reference to the subject matter under discussion at the convention of car inspectors and car foremen at Richmond, Va., September 14-16, inclusive.

I am particularly in sympathy with the work of your association, because my experience in the operating department has taught me the essential necessity of working in sympathy and co-operating with your men in transportation work. In the discussion of the subject that may come before you, the following items may be of interest:

It should be remembered that every man is an important integral part of the corporation to which he belongs, and his success and the business resulting from his work depends upon his conscientious effort to present inviting service to the public. Primarily we are in this business to sell transportation, and upon the quality of that transportation depends the amount of business we shall secure. Every man should feel himself a freight solicitor; whether he is making waybills, spiking rails, or inspecting or building cars, his work should be that of harmony and co-operation, with the thought in mind that he is improving the quality of transportation we are inviting the public to accept. To this end, we should talk of the merit of our company, of the service we perform, the quality of transportation we have to offer, and demonstrate the interest we have in the business of our patrons or new patrons we hope to secure. It is not sufficient to build a new car and ignore the inquiry of any merchant, simply because we may not be able to give him full information on the subject he has in mind. It is our duty, and should be our purpose, in doing our work, to let no opportunity pass to invite the good will of those who want to use our service. To this end, we should familiarize ourselves not only with the work of our individual department, but seek, co-operate and work in harmony with other departments, so as to intelligently conduct our own affairs and render assistance to those we work with.

When business is once secured, it is our obligation to perform the transportation as we advertise, bearing in mind that net earnings are to be conserved. Good transportation at low cost is good business, and in conserving the net earnings it is made easier if good equipment is furnished in the first instance that will carry the load from the originating point to the destination with the least possible delay. Every time a car is cut out we tax the revenue. Having in mind the principle that an ounce of prevention is worth a pound of cure, it is evidently true economy to spend money at the originating point rather than continuous expenditures en route.

At interchange points an intelligent inspector is worth the price of a day and night engine and crew. If he has in mind we all are freight solicitors, having transportation to sell, having secured the business it is under way earning revenue, and it is our duty to conserve that revenue, the man at the junction point becomes a most important factor. Thus he must determine when the cars are safe to run, and if not, where the repairs should be made, or if transfer is necessary. In making these decisions, he must take into account the mileage the car has yet to make, the kind of road it is going over, the character of the lading, and the train service in which it will probably move—all of which are important items having a bearing upon the decisions he is required to make.

It has been my experience to observe inspectors reject cars at interchange points with apparently no knowledge of the work involved with reference to yard switching, and no consideration of the movement of freight, while on the other hand it has also been my privilege to be associated with inspectors who exercised a vital interest in seeing that a proper inspection of the car was made at a point that would be least expensive in switching and least expensive in movement to and from shop yards.

In working in terminals, it has always been my purpose and practice to co-operate with the car men, and promulgate the principle that it was our obligation to first develop good service and conserve the earnings, and whatever rules or practices we adopted and followed, we made them bend to this end.

Yours truly,

W. F. Schaff.

Mr. O'Donnell: In deference to the ladies, whose cause I always like to champion, I say let them go. Our president is about as kind a man as there is, but I think he overlooks the fact that it is a very warm day.

President Hanson: In a few moments we will have a recess and then the ladies can retire. I am going to call on Mr. Wright, chairman of the entertainment committee. I think you all know him.

Mr. Wright: If there is anything this crowd does not know about me I would like to know what it is. I had no intention of running away, but by way of explanation will say that the committee is in the midst of a very busy session. We are making a little different arrangement in our plans. Our registration is not as complete as we would like it, and we want those who have not registered to come to the room and secure badges so we can take care of all of the guests. It may be some extra work, but it is going to give us a permanent way of handling it in the future.

The first night we will have our reception and musicale as usual, to be held in this room. We do not call it a reception, but it is the social gathering you all know of. The members will be in session this afternoon as is

their custom. This afternoon, at 2:30, special cars will come up at the Murphy Hotel to carry the ladies to the old St. John's Church, where, through the kindness of some of the good people of Virginia, the old sexton has consented to give us a talk on Patrick Henry. Tomorrow we have planned nothing in the way of entertainment for the morning. At 2:30 cars will take us to the Old Dominion dock to take us for a boat ride down the James.

We decided when we commenced to look around for a place to go that this convention should be here ten days or two weeks. We are going to go away knowing that we have missed a great many things. On Thursday afternoon, it has been our experience that a great many plan to leave, and we have planned a trip down to the Confederate Museum, where people can go and come at their own pleasure. We could not attempt to take the crowd in a body.

President Hanson announced that Mr. J. R. Gould, superintendent of motive power, had sent word down that any member, together with the members of his family dependent upon him for support, could secure transportation to Newport News or points along the line by making request at this time.

And at 12 o'clock a group picture will be taken for the "Times Despatch" at the capitol grounds.

For the benefit of the new members I am going to ask Brother Boutet to make a few remarks, he being one of our past presidents and having called the first meeting to order in 1897, or 1898. He no doubt can tell us something of its growth up to the present time.

ADDRESS OF MR. BOUTET.

When they asked me two or three weeks ago to say something down here I knew there would be a number of ladies, and my mind would become so confused that I would not be able to, so I jotted down a few remarks which I will read.

In the year 1897 we, at Cincinnati, were having considerable trouble in the interchange of cars, due to the fact that at nearly all interchange points throughout the country they seemed to have a different interpretation of the rules of interchange, hardly any two points having the same interpretation of any one rule.

This, you are no doubt aware, caused a great deal of hardship on the railroads, especially if one railroad was interested at any two large interchange points. which caused a large number of cars to be transferred or refused at one point that had been accepted at another in practically the same condition.

I took the matter up with the standing committee on joint inspection at Cincinnati and got their permission to call a meeting of the different chief interchange inspectors throughout the country to see if we could not get a little closer in our interpretation of the M. C. B. Rules.

There was present at this meeting Mr. Charles Waughop, of St. Louis; Mr. John Doyle, of Columbus, O.; Mr. J. C. McCabe, of Cleveland, O.; William Palmer, of Toledo, O.; J. W. Baker of Kansas City, Mo.; E. E. Merriss, of Lexington, Ky.; Fred Morgan, of Chattanooga, Tenn., and some of these were accompanied by members of the committees in charge of interchange at their particular points.

We discussed the rules that were giving us the most trouble at the different points, all realizing the good that could be accomplished by having one general interpretation, and we agreed on one interpretation on the most important rules.

Believing that we had accomplished a great deal of good and that a great deal more could be done by meeting once or twice a year, it was decided that we would meet in this manner, which was done up until Friday, September 22, 1899, when we met at Cleveland, O., and decided on a permanent organization, which was formed, composed of chief joint car inspectors.

We continued to run in this manner until the annual meeting held in St. Louis in 1904. The membership up to that time consisted solely of chief joint car inspectors, therefore only the larger interchange points were represented.

It was felt that the association's opinions would have greater weight with the Arbitrating Committee if the smaller interchange points also had a representation in our association, we, therefore at that time changed the constitution, making car foremen eligible to membership, and, gradually, by this means the association has become more and more representative of the small interchange points, as well as the large.

The object of this association has always been to get the correct interpretation of the M. C. B. Rules so that they will be understood alike from Maine to California, and to make such recommendations to the Arbitration Committee, as appears to them most essential.

The association has continued to grow in membership and importance as an association, composed of people employed directly on interchange, who are able to see the exact condition as same is presented from time to time, and which you will admit is constantly changing.

This association is being recognized as an organization of importance in the interpretation of the rules of interchange. second only to the M. C. B. Association.

Being subordinates of the M. C. B. Association, which is composed of our superior officers, in making our recommendations to the Arbitration Committee, we confine ourselves to what we consider the rules that are the more important and what will afford the most relief to all portions of the country, and not endeavor to have the rules so changed that they will benefit our particular interchange point and work a hardship on nearly all the other points. We try not to have the book of rules rewritten each year, bearing in mind that the framers of these rules are a body of men who inaugurated these rules and have been through all the trials of interchange, and that there are conditions to be considered other than the mere matter of switching a car from Railroad A to Railroad B track. If we will continue in this manner, I cannot see but that this association has a very bright future before it.

On behalf of the present officers, I will say that they have made a wonderful increase in membership, which has been sixty-one reported since our last meeting. This has been done by all of us giving our hearty support to the officers of the association, and I bespeak for the successor of Mr. Hanson that he shall have just as bright a future as Mr. Hanson has had. I feel very proud to look over this large audience and think that when I called the first meeting to order we only had seven members.

There is another thing I wanted to speak of to the members for the benefit of the officers. They are going to offer next year a premium to every man who brings his wife and daughter. Every man is supposed to bring his wife if he has one. I know it is possibly a hardship on some of you to bring your wives on account of the expense. I have to work the same as the rest of you and I realize that dollars are essential, and if you will all bring your wives you will have the kind of an entertainment that will do you a great deal of good.

President Hanson: One of the things that I referred to, and one that I hoped to see done in the next year, is to broaden the scope of this association through various committees. It has been my thought, and I have talked to a number of prominent railroad officials and they agreed with me, that we should appoint these committees and hold them responsible for having papers written and brought to the convention for discussion by the convention.

There seems to be a tendency to only change the M. C. B. interchange rules every two years, which I think is proper, and as a result it will be necessary for us to have something else besides getting an understanding of the changes made in the rules. With this end in view, it was my thought to line up various committees. I will only speak of one now and that will be a committee on car department apprenticeship. In talking to one of our friends on this subject he was so much in favor of it that he said: In order to get this started he would donate $50, which the committee can use as they see fit. Either giving the $50 to the one preparing the best paper on this subject, or divide it up. At the executive committee meeting this morning it was thought best to give to the one presenting the best paper, $25; to the next best, $15, and to the third best $10. The executive committee to pass on all papers before presented for reading, and in case they find any that they do not deem it advisable to present as a paper to the association, it will be withheld. These matters will all be worked out and you will be duly notified.

I have always felt that there has not been sufficient inducement offered to young men to enter the car department, and this will be a move along these lines. We believe, by starting something of this kind, it will result in better conditions. One committee will be appointed, consisting of chief joint inspectors, and one of car foremen, each handling the line of work laid out for them by the executive committee, and we feel that it will result in a great deal of good in the coming years. This will be worked out, it is believed, to the extent that you will all feel that it was a move in the right direction.

TUESDAY AFTERNOON SESSION.

The following letter was read by Mr. McMunn:

Mr. President, Ladies and Members of the Chief Interchange Inspectors and Car Foremen's Association of America:

I trust that this, your seventeenth annual convention, will be one of the most instructive, as well as pleasant, meetings you have attended, which, from my point of view, means a great deal.

Wife and I had intended to, as heretofore, enjoy the pleasure of again meeting you all this year, which is a pleasure that for years we have much enjoyed, but find it necessary to stay at home.

It is with considerable satisfaction that we both reflect on the many pleasant hours we spent among you. The pleasant recollection of the many friends we thus gained fills our hearts with a thrill of joy that acts as a balm on the wounds that time inflicts, and puts shining stars in our horizon of memory; that beckons us to gather for communion at the altar of friendship.

The work of the association is not confined merely to the remarks which may appear upon the minutes of each meeting, there are other and unwritten results—namely, the pleasant feeling of social felicity which is created among the members, the getting together in the corners of the meeting places, on trains en route to or from these places of meetings, and others, where one's personal affairs, which are most closely identified with those in general, are discussed and considered.

We get acquainted with each other and, as a result, a better feeling of good fellowship arises between fellow craftsmen, our wives become acquainted and enjoy our, otherwise to them monotonous, car talk, and, thanks to the supply men, have become tolerant and as enthusiastic in our affairs as ourselves.

It is with a great deal of comfort I reflect on the large acquaintances the association have given. When I search the twilight of my memory of the days when my acquaintance was limited to a few foremen in the immediate vicinity of our own line, and as I read communications or remarks in the mechanical publications, I pictured the writer or speaker according to the elasticity of my imagination. If fortunate in being able to connect a point or a line with the name of an individual, it was limited to the name, and its significance depended largely on the impression letters or remarks had imbedded in my mind.

But now which one of us could think of St. Louis without associating our broad-minded, friendly and wholesome departed friend, Charles Waughaup, his wife and daughters, his worthy successor and those of his immediate associates whom we have had the pleasure to meet.

Cincinnati, to our minds, would be as barren of attraction as a desert without "Bon Ami" Henry Boutet, the daddy of our association, through whom we have and are indebted for our associations; Abraham Lincoln in our secretary, Stephen Skidmore, whose name will always be associated with the annals of the association as its analystic years after his office has been occupied by others. Likewise we had a number of Hitches, of which, I believe, there still remain two—one, at least, that was always "hitched" to the association, and will always stand by it without being hitched, as he never caused a hitch—and we also gained a great deal by our Gainey, and all the equally loyal and highly efficient members, whom you all know and which would be too numerous to mention. They are all dear to me, and to mention their ladies might lead me to be construed as having become infatuated—and get in wrong with my wife—and I hope that none of them suffered from the storm and flood and will all be at Richmond.

And while I have duly dwelled on Cincinnati, Ludlow and vicinity, my mind wanders again over the vast plains and I see and hear Mr. Trapnell. How could any one of us think of Kansas City without Trapnell standing before one, or without feeling him clasping one's hand and in the clear, baritone voice say just what he meant and stick to it? It would be as impossible to separate the two as it would to mention Minneapolis, or think of Minnehaha Falls, Minnetonka and Bear Lake's clear waters, and the Northwestern ruggedness, thrift, wealth and hospitality, without seeing our long-time friend, Campbell, hat in hand, in soft voice welcoming you in a position that stands out in bold relief, and as pleasing in every picture of his pleasant surroundings that will always linger in our memory of our visit to Minneapolis.

I could not imagine anything about Omaha, even though my real object there, Mr. Cressey, had not forgot himself or rather felt enough gratitude towards our "Dad" to come to the old home of the association, without Cressey getting before my vision so distinct and forceful that I hesitate to think profane about cars from that district.

I am, however, sometimes tempted to forget that Forthworth, Texas, ever had a Hogset that I had seen, but immediately I see a big, good-natured Texan as his representative, and I give up and only hope to see them both again.

Neither could I fancy Cairo in existence, or go to an opera house with our "safety exits" in rear, without being reminded of my shipmate, Mr. Costley.

And how could any one good-naturedly contend with all the "Run Repair" or "Transfer Run," and not repaired or transferred, and leave meine liber Herr Schultz and his able assistants out of the arrangement? Could one forget all else that attach us to Chicago? It is with a considerable less vituperation that we leave our warm beds and the "wee hoose at necht" to respond to a call to repair a broken-down car of export beef of

the Armour, Swift, Morris or other packers, which as we cannot forget for all the momentary discomfort the many pleasant trips they have given us, as well as substantial lunches served us at that point and elsewhere.

And which one among us, in our daily pursuits of our duties, can execute a single function without being reminded of our many Railway Supply firm friends. Every drop of oil introduces a seine of Galena Oil men that we have met; every gray iron malleable or steel casting, jacks or other tools, every piece of lumber used voluntarily solicits our recollection of the many pleasant and instructive moments these gentlemen have afforded us, and their conduct in all their dealings prompts regard for them. To them we owe a great deal for the modern constructions of today; they are the promoters and gallant Sir Knights that, thanks to the keen conception and good judgments on the part of the heads of our mechanical departments, have made the rolling stock of this country the proud contract to what it was years ago.

The C. I. I. & C. F. A. of America has made a great and beneficial stride. This country, though the largest of all thoroughly industrial, as a result is harmoniously operated, distances have been lessened; there are practically no more strangers in our field.

The instant we see the initials of a road on a car we are reminded of some of its representatives, who are acquaintances or friends.

You think of Peoria, and you instantly see Pendelton vigorously debating some newly launched project; and the prominent part Columbus takes as Ohio capital does not obscure the prominence of our friend Vittium; and if you had trouble with stuff out of Youngstown, Ohio, you would immediately forget it when you could not help but recollect our regular attendant, Dyer, and his mostly silent, but always observing, comrade, S. Lindman, the two companions of the smoky but wealth-producing Mahoning Valley.

Since the days of our departed friend, and our first secretary, Mr. John McCabe, Cleveland, Ohio, in as far as we are concerned, would not enter into your minds without immediately, through the memory's telescope picture to you its stalwart and genial representative, George Lynch, ever alert to some terms in the rules that might he construed oher than as intended.

Toledo, like many other similar important points, where it has been our pleasure to visit, could not be forgotten even if onc possessed the most innate gratitude. One must connect it with Mr. Stoll, Forest, and the many stanch Buckeyes we have met there.

I have zig-zagged through the country, unwillingly skipped many important members, and among them Val Baltz at Wheeling and his assistant but they, I know, will pardon me.

I am near Canada and would like to mention all mine and your friends there, but my admiration for them all prompts me, in the absence of naming them all, to confine giving room to our tall and genial Celt, Carney, of the M. C., and the "Guid Scot" Miserall, of the G. T. One could not consistently think of the International Bridge without, in its connection, Mr. How, of Victoria.

And now comes the Hub of the East—Buffalo, N. Y. See how impossible it would be to, in any respect refer to any railroad or interchange there without you instantly see and hear the arbitrator of the Niagara frontier inspection, the silver-tongued orator with the broad shoulders and smiling countenance, Mr. T. J. O'Donnell, who has been your respondent to welcome addresses to the association for years, and always happily equal to the occasion, and thus endowed with the faculties to oratorically convey to us, and those who honor us with their presence, his heartfelt gratitude and kindly interest in the association, and all its members, as well as similar functions in kindred associations, which have made him one that needs no introduction, and to our minds inseparable from the thoughts of Buffalo and Niagara; and, I have no doubt, will be equal to the task at this, your meeting—if assigned, as usual.

Your worthy president is my "boss." If I should duly comment on him he might think I was doing it to get my pay raised; hence, I will conclude by a vote for my friend Kipp for our president for the ensuing term, which I hope you will make unanimous.

Hoping to be with you at our next convention, I am,

Sincerely yours,

A. Berg, Gen. Foreman, N. Y. C. R. R., Erie, Pa.

Mr. Boutet: I feel that as Mr. Berg is one of our pioneer members, and, while we should insert a copy of this letter in our minutes, it would be a rather indefinite way of answering Mr. Berg, and I would move that Mr. T. J. O'Donnell be authorized to draft an answer to Mr. Berg on behalf of the association.

Mr. O'Donnell: I want to add that it be signed by the president and members of the executive committee. I think it would be out of place if I did not say a word for Mr. Berg in his absence. Erie, the home of Mr. Berg, had a very severe catastrophe two or three months ago, and all of the officials of the New York Central, including Mr. Berg, have been working night and day to overcome the result of the flood. I heard from Mr. Berg and he said it would hardly be possible for him to come. I have many pleasant and intimate recollections of Mr. Berg and I hope our happy days with him will continue in the future.

The motion was seconded and unanimously carried.

Mr. Boutet: I move that Mr. MacBain's letter be spread upon the minutes and that this association answer it, expressing our sorrow at his misfortune, and best wishes for a speedy recovery.

Seconded and carried unanimously.

President Hanson: All of these letters will be published as a part of the minutes of this convention. There were several points in these letters and especially in Mr. Hennessey's that no doubt this association wants to take some action on at the proper time.

Mr. Boutet: He has brought out some points very essential to the welfare of this association. We are the people that are called upon often to make joint statements in connection with foremen of different roads as to the condition of cars. I would move that the paper be received; that a committee composed of the vice president, Mr. Carney, and Mr. Maddox be appointed to draft an answer to the communication and then put the letter before the association for approval or disapproval, thus letting us go on record as saying that we are endeavoring to carry out the wishes of the M. C. B. Association in this very important matter.

Mr. O'Donnell: Wouldn't it be far better to defer any action on Mr. Hennessy's letter until we come to a discussion of Rule 42, and we can then talk it over intelligently, because that it what it applies to. Let us hold that in mind and go over the rules until we get to that particular rule; then the committee will have something to work on.

Mr. Boutet: Mr. O'Donnell would make an excellent member of that committee, but I did not want to impose on him by making him work all the time.

President Hanson: If there is no objection we will defer action on this letter until we come to the discussion of Rule 42.

Mr. Stoll: I agree with Mr. O'Donnell when he says that we should take the matter up under foot note to Rule 42 and 120 when the time comes. We can then talk about what we are doing and what we ought to do.

President Hanson: If there is no objection, we will appoint the committee as Mr. Boutet suggests and refer this communication to them.

The following communication was read:

Cleveland, Ohio, September, 1915.

Subject:

"Wheel Defect and Worn Coupler Limit Gauge."

For some time past it has occurred to me that a change in the wheel defect and worn coupler limit gauge might safely, if not profitably, be made.

The present gauge having standard measurements for all wheels would indicate the presence of a standard wheel flange on cast iron, cast steel, rolled steel and steel tired wheels, and if that is a fact why cannot we have a condemning limit gauge measuring the thickness of wheel flanges, for, surely, it can easily be figured out just how much vertical wear will reduce the wheel flange to 1 in. or 15-16 ins. thick, as the case may be, and eliminate the vertical method of gauging, which is uncertain and difficult; also that few railroad companies are willing to run steel wheels until the flanges are worn to 1 in. or 15-16 ins. thick.

At present we have four methods of gauging worn flanges, two for wheels under 80,000 capacity, and for wheels 80,000 capacity and over.

It has been my experience that wheel flanges of 80,000 capacity and over, condemnable by the vertical method of gauging, are not condemnable by the horizontal method, as shown in Figure 3. Consequently, if that is a fact, the latter method would be unnecessary, and again if the wheel flange is safe at 1 in. and 15-16 ins. thick respectively (the inference is that it is safe), why should we condemn it before it has been worn down to that thickness, and further it is very difficult to find that worn condition of tread and flange as shown in Figure 4.

In brief, my idea is to use the method for gauging worn flanges as shown in Figure 3, even if found necessary to enlarge the opening in the gauge, as it is less difficult and more correct method from the car inspector's viewpoint.

Respectfully submitted,

George Lynch, Chief Joint Car Insptr., Cleveland, O.

Mr. Abbott: I move that discussion on all of the communications be deferred until the rule comes up to which the communications refer.

Seconded and carried.

The following letter was read by Mr. Boutet:

President and Members:

Interchange of cars, especially at large interchange points, is one of the serious problems of railroading, and one which requires a great deal of thought; but, as the writer sees it, not on account of the serious defects that exist on cars, but the small or trifling ones, which would not be repaired if the car was at its own shops, except that it bears a defect card covering same.

Some of the inspectors imagine that the number of defect cards they get from the delivering line is what places their value with their company. This is not the case at a few places in the country, but all over the country.

If a defect card is issued at one point, the movements of the car are traced and the inspectors that receive the car on that line are asked about same and why it was not carded. Continually receiving such letters, the inspector makes up his mind that it is what his company wants, and, as he is desirous of holding his position, falls in line and demands cards for all cars in accordance with what the technical man had done.

No doubt all of you will say this condition does not exist on your road or at your interchange point, but I can assure you that it does. If you do not believe it, give the defect card stubs a close inspection and you will find it is true.

Then you will no doubt say that it is the fault of the receiving line, but if you investigate the demands of your own inspectors on the delivering line you find it about the same.

This is something that the members of this association can overcome and it appears to the writer that it cannot be overcome at one or two points, but that this association is large enough to remedy his trouble generally.

Now let us go home firmly resolved that it is the common-sense view of the M. C. B. Rules, as interpreted by the Arbitrating Committee, and work to that end.

We will also instruct our inspectors that we are not looking for every twenty-five-cent piece that we can compel the delivering line to be responsible for, through a technicality, but we will have them look for only the serious defects—anything that will affect the safety of the handling of cars as to train movements and train men and protect the lading.

If we will do this we will save a vast amount of money each year that is now being wasted.

While we are holding the delivering line for the small defects, we are compelling them to do the same thing against our own line, compelling the inspectors to use more time in making the inspection.

There is too much time lost in looking for and carding for trifling defects that do not affect the safety or usefulness of the car.

This is a serious matter, especially in crowded terminals where it is absolutely necessary that the cars be kept moving to prevent the terminals from becoming blocked.

The most serious part of it is that it causes the inspectors to overlook defects that should be seen and cars are not set out that are liable to cause trouble.

Count the cars that go through your terminals for a week and note the number of cars that are carded for from two to thirty siding boards and side facia boards raked and broken, roof boards damaged. Examine the defects and you will no doubt find that siding boards and facia boards raked through the paint or scratched by the nails in the door, roofing boards that have the edges outside of the facia raked on house cars, and similar defects on coal and flat cars. Defects of this nature are causing more trouble in the interchange of cars today than anything else that I can see.

We are not following the instructions of the M. C. B. Rules, which, this association has admitted, are as practical as they can be made.

I hardly think that there is a member of this association, Mr. President, but what realizes that it costs more to collect on many defect cards than the face of the card calls for. This is surely not making money for the companies we represent.

It will take an inspector five minutes at least to make out a defect card and tack it on a car, and with from three to five cards to a cut of cars you have delayed that cut of cars fifteen to thirty minutes and you cannot delay a switch engine and crew for less than ten cents per minute. Has any money been made for the company in the transaction?

Not to mention the delays that are caused every time a car is interchanged, in making records of cards that are on same.

I have not mentioned any of the other delays that are caused in the yards by this individual delay to this cut. Sometimes you have delayed two other crews through the delay to this one, not only in your yard, but in the other yard as well. This money has to be paid by the companies that employ us.

There are many other reasons why we should try our best to remedy this evil, and I feel that if we can do this we have relieved the interchange of its worst trouble and saved money for our companies and worry for ourselves.

Let us resolve to handle cars in interchange inspection on broad lines.

H. BOUTET.

Mr. Elliott read the following:

To the Officers and Members of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, Assembled in Convention at Richmond, Va., September 14, 15 and 16, 1915:

The following is submitted for your consideration and further action, and I would recommend that suitable committee or committees be appointed to carry out the plan suggested.

This association should be known as the Car Foremen's Association of America (or any other suitable name).

The membership should be the combined membership of all organizations of car men and their associates now formed in the various cities. The proceedings of the monthly meeting of the local organizations should be forwarded to the secretary of this or the general association for printing under one cover. This would be less expensive than at present with each locality printing their own proceedings, and it will further the purpose for which these local organizations were formed, namely, the bringing together of car men for the exchange of ideas and the general betterment of car interchange and repairing, and will make the exchange universal instead of local.

This would also keep us in touch from month to month with the conditions over the entire country, for instance, the proceedings of the association at Chicago would be in the hands of the members of Kansas City, Cincinnati, St. Louis, Buffalo, etc., and we would have the opportunity to discuss questions and conditions that have come up at that point, and those discussions in meetings would automatically be returned to Chicago. In fact a general better understanding of universal conditions would be had, and undoubtedly the interchange and repairing of freight cars would be largely benefited.

This association meets once each year, and the M. C. B. rules are gone over thoroughly and discussed and we arrive at what we believe is the proper amount to proceed under them, but the circulation of our discussions is so small compared to the number of interested persons that should be reached that a great deal of the good is lost. If the plan I suggest is carried out practically every car man in the country will know what we have done through our proceedings. This would be of great value to car inspectors and repairmen, who do not have the advantage of the many meetings that car foremen and chief inspectors have.

At the time of the year when the revision of M. C. B. rules is being considered committees from each local division should be appointed and the rules that we feel need changing should be sent to the general secretary, he in turn to forward them to each division for their investigation and report; these committees to make their reports to a meeting the same as the meeting of the executive at the present time. This would eliminate a great many of the recommendations that are now made and would show that what was recommended was the compact opinion of the many points of interchange and not local conditions. This, I am sure, would greatly assist the arbitration committee in their deliberations, and they would know that the suggestions were the result of the practical workings of the rules, and would show whether or not the actual necessity for changes existed. The committee, as you know, did not ask for suggestions last year for the reason that they thought that the rules should stand over another year with a few exceptions, and I believe that we can be of much assistance to the committee by having each point act as suggested above.

This plan would have to be submitted to the various local division, but I am sure that they will see the benefits to be derived, both by the local divisions and the country in general. The expense could be handled on a per capita basis and would be much cheaper than at present, and the plan will no doubt meet with the unanimous approval of our superiors.

W. B. ELLIOTT.

The Secretary and Treasurer's report was read as follows:

Secretary-Treasurer's report for year ending September 11, 1915:

GENERAL FUND.

On hand last report	$31.19
Receipts	637.00
Total	$668.19
Disbursements	$594.78
Balance on hand	$73.41

ENTERTAINMENT FUND.

Receipts	$247.73
Turned over to Entertainment Committee	247.73

MEMBERSHIP.

In good standing	327	Increase during year	30
In arrears for one year's dues	86	Decrease during year	10
In arrears for two years' dues	83	Increase during year	54

DEATHS DURING YEAR.

F. W. Chaffe, General Car Inspector, N. Y. C. R. R., Albany, N. Y.
G. M. Bunting, General Car Foreman, Pennsylvania Ry., Cleveland, O.
F. X. Schuler, Foreman Inspectors, N. Y. C. R. R., Auburn, N. Y.
S. Mann, Chief Interchange Inspector, Detroit, Mich.

STEPHEN SKIDMORE,
Secretary-Treasurer.

President Hanson: If there is no objection the report will be handled in the usual way by being referred to the executive committee for auditing.

The General Secretary of the Railroad Y. M. C. A. wishes to extend to this association all the privileges of that association.

A motion to adjourn was lost and the regular order of business taken up.

On motion of Mr. Elliott a discussion of the rules that had been changed was taken up first.

RULE 2, PAR. E.

Mr. Pendleton: Would acceptation or rejection of a car under paragraph C be justifiable on account of an overloaded car offered in interchange?

Mr. O'Donnell: Not from a mechanical standpoint.

Mr. Pendleton: An inspector rejects an overloaded car and gets behind the exception. I say Section "C" does not apply. We can say that the car is improperly loaded if it is overloaded. If you refer to A. R. A. rules you will see the same statement.

Mr. O'Donnell: I should say that does not enter into the question of lading, as to the weight, in any manner whatever. That is strictly a matter for the traffic department. It means that it hasn't the required number of side stakes, or something of that sort.

Mr. Kipp: I think Mr. Pendleton has raised an interesting question.

Mr. O'Donnell: We are no more responsible, as mechanical men, for an overloaded car than we are for damage to lading.

Mr. Elliott: That is our transfer rule that we have to work by, and if we stop to look at it, it practically says that we do not necessarily have to make repairs to cars to keep them under load. I believe that this association at this convention ought to be, not exactly a step in advance, but at least equal. Last week in California the American Association or railroads got together and recommended a flat transfer rule by which, if a car can be repaired in 24 working hours it should not be transferred. I believe that this association ought to disregard this rule and go on record for a 24-hour transfer rule. We have tried it in St. Louis twice and changed to suit different people. We found that we had to repair more cars under the 24-hour rule than under any rule. I do not believe that we ought to expect freight solicitors to go out and get freight and let one of us stop it because the car has one draft sill broken. If we had to take out of our pay rolls the cost of the transfer of the freight we would think two or three times before we did it.

Mr. Lynch: It seems to me, if I understand Mr. Pendleton rightly, that Brother Elliott is not speaking on the question. Mr. Pendleton says that he wanted an expression as to the understanding as between improperly loaded cars and overloaded cars.

Mr. Pendleton: That isn't my question. Rule 2 makes it compulsory to receive all cars with the following exception. I had one case where a man rejected a car offered in interchange claiming it was improperly loaded and it was an overloaded car. I contend that he had no right to reject the car. I want to know whether the rejection under Section C was justified.

Mr. Lynch: It was not a mechanical defect and as mechanical men we cannot refuse the car. The transportation man has a right to reject it and can send it back if he sees fit. The car can go forward and the load be removed at the expense of the delivering line.

Mr. O'Donnell: That is exactly what is being done under our association at the Niagara Frontier, but we are not taking part in the proceedings. It is strictly a matter of the Operating Department. If you will permit me to speak on the question brought out by Mr. Elliott, St. Louis is 1/50th part of the United States. We went into Chicago on the instructions of our superior officers to meet with the arbitration committee. They asked for a list of defects on cars which should justify a transfer and for a list which should not justify a transfer. Our president gave a great deal of thought and attention, after consulting with the different interchange points, and we submitted this list to the arbitration committee. It received the approval of the American Railway Association. We were asked to consult with them at the Master Car Builders' Association convention as to the propriety of the action and the whole association approved of their action. Now we come back here and Mr. Elliott wants us to back down. There isn't an item in these rules for which a car should be transferred that is not exact, plain, business-like and proper, and I do not think we should waste any time on it. We should interpret what the association gives us.

Mr. Schultz: I understand it as does Mr. O'Donnell. M. C. B. Rule 2 heretofore stated plainly in so many words that unless a car had defects, according to M. C. B. rules, and was not safe to run in accordance with the rules, it must be accepted. As a result of the agitation this rule was brought out. As I understand it, the Master Car Builders' Association expect us to unanimously adopt it as written in this book, and I therefore move you that it is the senseof this association that all special agreements in the way of modifying A. R. A. Rule 15 and M. C. B. Rule 2 be done away with as of October 1.

Mr. Boutet: For some reason or other Brother O'Donnell and I are agreed on this. We met in Chicago and they asked us to do everything we could to get a harmonious transfer rule that would work all over the country. We have got what we asked for. We come here to interpret the rules. We have no right to say that we will ignore them. The only thing we can do is to interpret what the rules mean and follow that. In February, if we have any changes to recommend we can do so then.

Mr. Elliott: In answer to Mr. Lynch, I want to say that I was not at this meeting and did not know anything about it. I did not know that we recommended it, but I want to tell you that there are about 100 defects that can be repaired on the car in five hours. If it is business to transfer that car, take that load out for 24 hours. I can have no conception of what railroad business is.

President Hanson: It is very warm and there is no need of starting unnecessary discussion. We are here to interpret the meaning of the changes in the present rules as laid down by the Master Car Builders' Association. I will declare it out of order because it is not in line with the constitution and by-laws at this time.

Mr. Pendleton: Mr. Schultz moved that all special agreements be eliminated as of October 1st. A. R. A. car service rule, under which we are going to be governed, still reads "unless otherwise agreed." I cannot see that the additions that have been made to the rule are going to hurt us. We can carry them right out, but the proper time to discuss transfer rules is when we get further along. This association ought to get up a rule and make it clear what the defect is in the present rules. As it is we are going to experience difficulty. We do need badly a uniform rule. We have one rule at one point and another at another. I believe that this association can recommend a rule that will be entirely satisfactory.

Mr. Boutet: Mr. Pendleton was not at Chicago last February. We received a letter asking us to submit what we considered a proper rule and we have until next February to consider it.

Mr. Abbott: Rule 2, Section 5, tells what defects must be repaired while the car is under load. I am at a point where I get lots of cars loaded with 8 ft. 4 ft. in diameter rails and I defy anybody to put in a center plate without transfer. If they cannot do the work on their own tracks, haven't I the right to a transfer order

Answer: Not according to the rules.

Voice: Would you not think that this is a case where the local agreement should stand? I say I will fix up the car all right, without taking it out of service.

Mr. O'Donnell: You have cars going the other way in the district, do you not?

Answer: Yes, and they hand them back to me.

Mr. O'Donnell: Then it is up to you to do the same.

Answer: If they would only do it, but they won't.

Mr. Lynch: It seems to me that is a local matter. There are probably not two points on your system so situated that repairs cannot be made both ways. These rules are made for the entire United States and Canada. The Master Car Builders' Association cannot make rules to govern every little point throughout the country, and if you are so situated that your neighbor will not repair your cars and you are required to make repairs both ways, that is a local condition that you and your neighbor must take care of. I think it is foolish for us to condemn the rules simply because they do not apply in every sense to every particular point.

Voice: I do not think the members opposing Mr. Schultz's motion are against the M. C. B. rules. Mr. Schultz's motion was to eliminate all special agreements. You cannot do that. You have got to take care of certain conditions.

Mr. King: We should be interpreting the rules and I believe we are talking on whether the rules are any good or not.

Mr. Kyle (N. Y. C.): Doesn't this local agreement simply mean from one place to another where a car is going to be unloaded? Two companies won't make a local agreement to pass a car to a third party.

President Hanson: Local agreements in some places are made between three companies.

Mr. Schultz: My motion was that it is the sense of this body that the intention of the framers of this rule was that after October 1st next, A. R. A. rule 15 and M. C. B. rule 2, are to be carried out literally throughout the United States and Canada; that all special agreements under said rules should on that date be abolished.

Carried.

RULE 3 F.

Mr. O'Donnell: I would like to hear from Mr. Keith of the Dold Packing Co.

Mr. Keith: We have been using tanks for retaining brine and at present we have 34 cars out of our equipment in Buffalo, but as this rule has been extended another year, we have tanks that are probably good for six months. They will not permit brine retainers to be applied to those tanks. We will not apply brine retainers until it is necessary to remove those retainers. I am satisfied that the private line men will heartily accept this extension.

On all cars that I have noticed over the couutry and especially with old cars, over the hatch cover at the left hand corner, there is a special desire for releasing brine. You will find the words "Release water before you ice."

Question: How are the inspectors to determine whether or not this car should be equipped?

Answer: The rules provide for that.

Voice: As I understand it, these are all refrigerator cars and there must be no scattering of water from station to station.

Voice: Does any car that carries ice necessarily have to carry a brine retainer?

Mr. McMunn: The rule seems to be clear in stating that only such cars as require for their refrigeration the use of salt with ice, and which are equipped with brine tanks, will be rejected after Oct. 1, 1916, unless provided with suitable device for retaining brine between icing stations. This would indicate that all cars which carry ice do not necessarily have to be equipped with brine retainers but that cars requiring brine retainers must have retainers of such design as will carry the brine between icing stations.

President Hanson: How are the inspectors to know whether it is loaded with dressed meats or other freight?

Mr. Keith: We load at Buffalo about 30 per cent. in foreign equipment. They are equipped with grates. We load one car with fresh meats. We allow 12 per cent. of salt and have instructions for re-icing. How is the inspector going to tell whether it is fresh meat or not? If it is a private line car that is carrying a tank, it must have brine retainers. What is the difference in the water that comes out of this railroad car with 15 per cent. salt, compared with our own car that is carrying a tank?

Answer: It all depends on the load that is in the car.

Mr. McMunn: It seems to me that the man who makes the initial inspection should know with what commodity the car is loaded and if brine is used in refrigeration. He, therefore, would be the one to say whether the car should be rejected in interchange.

Mr. Keith: Cars coming down to be loaded in Buffalo—we order 12 cars: probably load 6 with eggs, the next is loaded with rfesh meat, and the next with salt meat. Who is going to stop this loading?

Mr. Lynch: I think that rule is another transportation rule. The mechanical men do not handle billing. The car inspector has no means of knowing what the car is loaded with.

President Hanson: I think when the rule becomes effective, they will look to the inspector for this information.

Mr. Demint: I will have to disagree with Mr. Lynch. It is not a trausportation matter. At a majority of the points the car inspector is the one who has to look after the refrigeration of cars. To get an idea of the amount of ice in the car, it will be necessary for him to find out what is in the car. It is not a question of the car; it is a question of the product. If there is no information, the only recourse you have is to find out from the billing.

Mr. Ubanks: I move that we refer it to the executive committee as it is a long time before we have to consider that. Let the executive committee ascertain such information as may be necessary and have it incorporated in the rules.

Mr. O'Donnell: I agree with him. The reason for this rule being promulgated was brine drippings. Now they tell us that the drippings have to be held between icing stations.

The motion was seconded and carried.

And thereupon the convention adjourned until morning.

WEDNESDAY MORNING SESSION.

Telegram received from Mr. Stark and a letter from Mr. Thompson as follows:

Englewood, Ill., September 12, 1915.
File 51

Mr. F. H. Hanson, Pres.,
Chief Interchange Car Inspectors'
and Car Foremen's Assn. of America,
care Murphy's Hotel, Richmond, Va.

Dear Sir:—

Referring to your letter of July 30th, which, through oversight, became mixed up with a number of closed files and was put away in my desk and has just come to light, in connection with the annual convention of the association Sept. 14th, 15th and 16th at Richmond, Va.

From the fact that this letter became mislaid, I do not wish it taken as a sign that I had forgotten all about the association, for, as you know, it is one than cannot be lost sight of in this manner.

For some time I have been endeavoring to arrange my work so it would be possible for me to attend the convention, but due to unforeseen matters arising I now find it will be impossible for me to do so, which, to say the least, I sincerely regret, as it was one of the bright stars in my heaven of pleasure and business, knowing as I have what has taken place at previous conventions in both lines.

The future welfare of the association is obvious, as the work done by it compels interest, having the knack of work dcne being well done and to the best interest of all concerned.

Unable to attend myself, I wish to assure you that I have taken a hearty interest in having all members of this association I have come in contact, as well as any others, attend, as I feel that the purpose of the association is a very worthy one and attendance of their meetings and conventions is an uplift to any.

Yours truly,

GEO. THOMSON,
Dist. M. C. B.

RULE 21.

Mr. Eubanks: I would like to ask in regard to coke racks that have open tops and a rod through them, those that have no running boards or hand rails, whether or not we could make a charge for putting on those running boards on the open top cars and also for hand rails on the open top cars that have running boards and no hand rails.

Mr. Donohue: Coke cars do not come under that rule, but if such work is done for safety of trainmen it is believed a change is permissible and car owners should take no exception.

Question: What is referred to in here as "empty well hole cars"?

President Hanson: My understanding is that some roads have cars built with an opening in the center for hauling large wheels and machinery. Heretofore, when the load has been taken off those cars, they have been allowed to go back. With the opening not boarded over the trainmen are liable to walk into the opening; this rule is to take care of such a case. When the machinery is unloaded from such car, the line handling the car has the right to temporarily put boards over these openings.

RULE 33.

Mr. Armstrong: I would like to ask a question. Does it mean what it says? Are they cardable defects?

President Hanson: Yesterday it was decided that we discuss all the changes first, and when we get through with them we will then refer to any rule in the book.

Mr. Armstrong: I stand corrected.

RULE 42.

President Hanson: This is a rule that there should be a great deal of discussion on. That is something we have been trying to get the M. C. B. Association to do for years and it is gradually coming our way.

Mr O'Donnell: This more or less carries out your energetic work in trying to have same incorporated in the Master Car Builders' rules. I might say this for the district I represent. I have signed upwards of 1,500 itemized certificates for three items, and if I recall correctly, all that have ever been questioned were three cases. It appars that the car owner has implicit confidence in the joint inspector. I have turned down possibly 300.

Mr. Elliott: It seems to me that in comparison with the rule last year this rule has been narrowed down until it is going to be hard sometimes to make joint statements; for instance, the last part. Wherever you find a sill badly decayed you will find a crack or break. Joint statements will be hard to sigu, and sign right, under that rule. They are going to make it necessary to write the owner. I am fearful that we have narrowed up on that instead of broadened out.

Mr. Cressy: My understanding is that they make repairs as heretofore.

Mr. O'Donnell: As I understand the rule, if you have anything beyond the three sills, you have to take it up with the owner before you have the right to charge him for the repairs. It is optional with yourself whether you take it up with the owner. I think the Master Car Builders Association is more proud of this change than they were a year ago. They haven't the least suspicion of tying anybody up. Wooden frame cars are fast going out of existence. I think we are in a position to handle the responsibility for these breakages very nicely.

Mr. Elliott: It has been my experience,—we in St. Louis make more joint statements than anybody on account of the amount of foreign cars. We have had several cases that are plainly car owners,—every sill in the car was badly worn. It seems to me that the chief inspector should have authority to say that that is a car owner's defect. The arbitration committee well knows the conditions that confront us, and I believe that while we have a car that indicates car owner's defects, let us repair it. In the last year, personally, I have handled 500 joint statements with not one single complaint, under Rule 120 and foot note. I believe they could have gone further and given us the option to repair car owner defects, regardless of how many or where we found them.

Presideut Hanson: We should confine ourselves to the interpretation of the rules as now written. Any changes in the rules will be brought up in February.

Mr. Elliott: While that is true, I have heard a great deal in the last two years. We have now 413 members and when you meet in February you will have possibly 75. I believe it is a good idea to get the benefit of the opinion of those present.

President Hanson: I agree to a certain extent, but it is the custom of this association that if any one cannot attend the executive committee meeting when the changes are to be considered, that they forward their recommendations as to changes, but I cannot agree with the statement that we have plenty of time. We have only this one session today on account of the boat ride. Tomorrow morning will be taken up with the election of officers and other routine business. While I would be glad to permit as much talk along these lines as time permits today, let us confine ourselves as closely as possible to the interpretation of the rules.

Mr. Schulz: I feel that the rules are in such shape that we can handle the business all right. The last paragraph refers to cars such as flat cars where the sills are decayed or where metal body bolsters wears the bolt holes oblong.

Mr. McMunn: If the discussion is closed in connection with the foot note under Rule 42 as applicable to decayed or cracked sills, I would like to hear how Rule 42 is being interpreted by the interchange inspectors and foremen throughout the country concerning decay to end posts. To make myself clear: Assuming I have an end of a car burst out due to decayed end posts. Can I make up joint inspection statement indicating thereon that there are 4 decayed end posts and render bill to the car owner?

Mr. Schultz: I have always thought that decayed end posts are handled in the same manner as sills. Where we have a combination of four broken end posts and find one decayed, we bill the car owner.

Mr. Donohue: This foot note says sills. You are reading something under the rules that the Master Car Builders did not put there.

Mr. Hunt: Doesn't the 10 per cent. clause govern the amount of work that you do on a car? Doesn't 10 per cent. valuation of the car take care of this part of the rule?

Mr. Schultz: I have refused to issue defect cards for broken end posts where one of them is found decayed.

Mr. Elliott: We have use that rule on decayed end posts. I understood it to mean that they wanted to relieve the delivering line of car owner's responsibility.

Mr. McMunn: I would like to get the opinion of the interchange inspectors at some of our larger points, as well as the car foremen, and find out how they interpret the rule. There seems to be a diversity of opinion as to whether it is applicable to the end posts as well as sills. The foot note refers to sills and there is no mention of end posts.

Mr. Abbott: I had one case last spring, both of the corner posts and one of the center posts were decayed; the other was broken. It was shoved off by the load in the car. I made out joint evidence, attached it to the bill, and sent it in. That was seven months ago and it has not returned.

President Hanson: It is your understanding if you have over a combination of three end posts due to decayed parts, you can have a joint inspection statement rendered?

Answer: I believe it should be possible.

Question: If three posts were renewed on account of decay and one broken?

Answer: Yes, and joint evidence attached. It would make a total of four posts.

Voice: The fact that seven months have elapsed and you have not heard from it is no evidence that you will not hear from it.

Mr. Kipp: I believe it is the intention of the car owners to be fair with one another, and if we are fair with the foreign car owner when we have the car on our line, and get him joint evidence, saying that the primary cause of the failure was decay and age, and sign the joint evidence to that effect, we will not have any trouble collecting our bill.

President Hanson: The old rule says, "when a combination of defects involves decayed parts." That does not confine itself to sills. It would take in any parts, but the new rule mentions plainly sills. I would ask Mr. Boutet what he would do in this case if he were called upon to make joint inspection in Cincinnati.

Mr. Boutet: We would endeavor to confine ourselves to the combination and if there was more than a combination we would refuse to give a joint statement. We have exceptional cases—I am afraid to quote them for fear I would be misunderstood—we have conditions where we do have decayed posts and they are renewed solely on account of decay. I have in mind very strongly a letter that Mr. Hennesey sent us and I think it should be read before the case is discussed. People around the country had been prone to give joint evidence disregarding the owners. I believe the man that gives joint evidence should represent the owner and endeavor to be fair with the owner and with the road that has the car in its possession. In the talk with Mr. Hennessey and Mr. Brazier at Chicago, they seemed to have a fear that somebody was going to take advantage in order to get a few dollars for their company at the expense of the car owner. I only hope that this association will go on record as opposing any such practice. We have the respect of the arbitration committee at present. Let us not do anything in the convention or otherwise that is going to betray that confidence. Let us say: "It is true that these posts are decayed some, but if it had not been for the rough usage it would not be necessary to repair them. I would not sign a joint evidence for decayed end posts if it were not apparent that these decayed end posts would not have been damaged had it not been for rough usage. If we looked at it that way I do not believe we would sign for four end posts. I think we should go on record that if it exceeds the three end posts, or three sills, we ought to say it is not owner's defects, but rather responsibility of the road having the car. Let us consider that we have our own cars on the other fellow's line and let us give him exactly the same treatment that we wish for our own cars when they are under the other man's jurisdiction. As Mr. Hennessey has stated, there have been some exceptional cases where somebody has given joint evidence that looks suspicious. It would have been a hard matter for this association to have reached the point where we received recognition from these officers, if we had not confined ourselves strictly to the rules, and we can only retain it by being square. If theree are three posts broken we have to confine it to that.

President Hanson: It is his understanding that if we have a car with four end posts requiring renewal, even if three were decayed and one broken, it should be a delivering line defect.

Mr. Eubanks: I am inclind to agree with Mr. Boutet only a little bit more so. I think you cannot properly sign joint evidence for end posts under any circumstances and collect for them. I do not think we ought to do it because there is absolutely nothing in the rule. We are wasting a lot of time on something that is not in the rule.

Mr. Halbert: I differ with some of the remarks regarding the end posts. I have been in the habit of signing joint statements whenever there were three end posts decayed and one browen new. I look at it that the car owner should be responsible for any decayed parts to the car. I have had several cases where we have called the foremen representing the different lines and told them that according to the rules I could not very well sign joint statements. However, I would put the case up to them. I would say: "That is ours. We are strictly responsible. I will sign the joint statement," and he said: "You are correct." I have signed quite a number for decayed parts forming a combination and I do not think I have had one returned yet.

In the foot note under rule 42—we all know that rule 42 has reference to posts: 41 has reference to a combination of sills. If we couldn't use the foot note under 42, combination on the end, why didn't they put the foot note under 41?

Mr. Elliott: We have at St. Louis a lot of Southern cars coming up loaded with lumber. We have to stop them there, and we find more than any one place in the country. I will say that in nine out of ten cars we find two, three and four decayed end posts. If we are going to penalize the delivering line, speaking from the standpoint of our company, we are entitled to a defect card—but is it fair to penalize a delivering line for decayed parts under any condition? If it is, I cannot see it. This is a big proposition. If we do we are going to penalize the delivering line for a lot of stuff for which it is not responsible. I think the arbitration committee just failed to put in that part. I believe that they did not intend to penalize the delivering line for decayed parts.

Mr. Stoll: I think it is right to sign joint evidence for decay that exists regardless of whether there are three or four posts.

If you only have three posts you do not have to. The rule says if a combination exists and part of it is decayed, then you have the right to sign joint evidence and the owner becomes responsible.

President Hanson: Your understanding is that the foot note applies to 41 also?

Mr. Stoll: Yes.

Mr. Pendleton: I think we should confine ourselves strictly to the rule because a deviation from the rule has caused comment.

Mr. McMunn: In order to get it before the convention, I move you that it is the sense of this meeting that the foot note under Rule 42 properly belongs under Rule 41, and furthermore, that it is the sense of this meeting that the foot note under 42 is not applicable to that rule; but is applicable to Rule 41 only.

Motion seconded.

Mr. Hall: If I understand Mr. Elliott on the ends broken out—how does he get this joint inspection for the decayed parts? I presume the line that Mr. Elliott works for—we all understand they have no cars of their own—have a hump in their yards and the ends are broken out by the load shifting. The majority of them are broken in the center of the car, and that if these decayed parts are generally with the tenons down in the post castings, he knows nothing about the decayed part until he strips the car down to renew the four posts. If he becomes responsible for breaking out that end by the load shifting and he can strip it down and find the tenons decayed from one of those posts, I would like to ask him if he gets joint inspection and penalizes the owner for a combination due to one of the posts being decayed at the tenon when he knew nothing about it?

Mr. Elliott: I am surprised at the question. As long as I have known Mr. Hall I hope I have the reputation of being fair with him. If we break two corner posts and two end posts, and they are gone at the bottom, I would not ask anything. But if you are going to penalize me when I have got a car with two broken end posts and two decayed and leave these posts in that car, what can you expect me to do when I find that car? That isn't one case, but many cases I had seven last Monday, the same kind of cases

The question was put upon the motion and carried.

RULE 58.

Mr. McMunn: Under Rules 58 and 59, I want to get the opinion of the interchange inspectors as to how they construe these rules with respect to renewal of air hose. Under 58, missing air brake hose is delivering line responsibility; under 59, torn air hose is owner's responsibility. If I have a car to offer in interchange with the hose torn off at the nipple, would I be justified in issuing a defect card upon request, or should I consider it torn hose? Is a hose torn off at the nipple and the part with the coupling missing, a missing or torn air hose?

Mr. Hulbert: The way I have been handling that under Rule 59, I consider a torn air hose as car owner's defect; the coupling being gone, I have decided it was delivering line defect. If the delivering line had taken advanatge of the opportunity to repair the car before delivering it, they could have charged the owner for the hose complete and given them proper credit. That is the way I handle it in St. Louis.

Mr. Boutet: You make the owners responsible for the rubber; delivering line for the coupling?

Answer: Yes.

Question: If the air hose is torn off and one coupling is missing, you give a card against the delivering line for the one coupling?

Answer: Yes. And let them charge the car owner.

Mr. O'Donnell: It is my understanding of that rule, and I think it has been for some years, that if an air hose is torn off in ordinary switching service and not uncoupled by hand—if you take advantage of this rule you can charge the owner, but the minute you deliver the car, the delivering line becomes responsible for the air hose. You have no right to charge the owner when you handle the car in interchange.

Mr. Hulbert: That might be the interpretation at certain points. It says torn or worn air hose is owner's responsibility. There is nobody handling torn air hose that knows anything about how it is torn off. Torn air hose is owner's responsibility. Rules 58 and 59—air hose under one rule is car owner's, and the delivering line is responsible for the missing coupling. The way I look at it, the rules do not make the coupling owner's responsibility in interchange. You can repair it and charge it to the owner by giving proper credit. The delivering line has the coupling in its possession. They have nothing to give the car owner. The delivering line has the scrap and I say the coupling is a delivering line responsibility and the hose is not.

Mr. O'Donnell: By what line of reasoning can you take advantage of the owner. On missing brake beam parts you have promised to charge only for certain repairs. Just the minute you give the car to the other fellow that right ceases. I think you are carrying out the old theory of being unfair to the owner when you take advantage. We are preaching that we are fair and strictly honest and we publicly get up and take advantage of the owner.

Mr. Zweible: Isn't that all covered in Rule 2, paragraph A?

Mr. Keene: I think if you will refer to the arbitration decisions you will find that there has been a case decided where the road delivering the car in interchange with air hose torn off and one air hose missing, and made the notation "on account of hose torn off" the road making the repair billed the owned for one new air hose and gave credit for the coupling and the nipple. The M. C. B. Association decided it was correct.

Mr. Eyman: A few years ago before there was anything said in the rule about torn air hose there was an arbitration case which I was interested in. That point was brought up by the committee and they decided that a torn air hose was owner's defect, and since that time it has been in the rules that torn air hose was owner's defect, and I think it was for the purpose of making plain their decision in that case.

Mr. Boutet: I cannot help agreeing with Mr. O'Donnell once. I will say he is correct. If that air hose is torn off the road having the car in its possession has a perfect right to charge the owner for that hose, but if the car is delivered to a connecting line, I believe the line delivering the car should be responsible for the hose torn off.

Mr. Elliott: I believe in November, 1910, that a ballot was taken to eliminate penalizing. There has been some contention that it is all fair usage. We asked Mr. Taylor to decide the question. I believe Mr. Hulbert is right—torn air hose is owner's responsibility. The fact that we find many with defective couplings—they are designed to uncouple automatically, and if they don't it becomes a car owner's responsibility. A torn air hose is owner's responsibility.

Mr. O'Donnell: I move you that a strict interpretation of the rule on torn air hose, due to switching, is an owner's defect, but if car is offered in interchange it becomes a delivering company's defect.

Seconded and carried.

RULE 108.

Mr. Forest: The second paragraph of the rule says no charge shall be made for the material or labor of lubrication. Does that include the sponging or just the oil?

President Hanson: I would say it means both.

Mr. O'Donnell: We have never charged a car owner for the packing and have no right to charge.

President Hanson: That has been brought up by various associations and recommendations made to the M. C. B. Association to have a charge put in the M. C. B. rules with the privilege of billing the car owner. It has never been approved by the M. C. B. Association.

RULE 120.

Mr. Eubanks: There are a good many cars that are being hauled up and inspected under Rule 120, and the owners desire that they be equipped with safety appliances. I would like to know whether it is considered right for the owners to furnish all the safety appliances for equipping the cars. We would much prefer to order the safety appliance material direct from the owner as in the case we have on hand now.

Mr. Elliott: All the owner ever does is to furnish blue prints. Sometimes he says: "Equip it according to law." You could not ask him to furnish grabirons because he would tell you to take them out of your stock.

President Hanson: You have to be governed by the rules, as they show what material the owners shall furnish.

Mr. Eubanks: I understand that, but I would like to have it generally understood how they could handle that to best advantage. There is a particular case. We have had considerable amount of trouble. The owners did not furnish us with the print necessary and we would very much rather have them furnish the material. They can furnish it cheaper than we can.

Mr. Abbott: I would like to ask if the depreciation is taken from these parts before you figure the 10 per cent. on the face price? Suppose you have a car 15 years old and it is under joint evidence, do you figure 10 per cent. or depreciate it 15 years and then figure?

Voice: If you take the value under Rule 116 you cannot allow any depreciation.

Member: "Where the labor cost of repairs exceed 10 per cent." Does that mean labor alone?

President Hanson: That seems to be the intent.

Mr. Heil: Rule 120, if you have four sills decayed and cracked, how would you handle that, under foot note Rule 42?
you handle that, under foot note Rule 42?

President Hanson: Yes, that comes under Rule 42. I would say. What do the rest understand?

Mr. Elliott: Do I understand that that is all there is the matter with the car?

Answer: No, it has other defects and decayed parts.

Mr. Elliott: I would report that to the owner.

President Hanson: If the car is in such condition that it would come under Rule 120.

Mr. Schultz: Tell the truth.

Mr. Keith: Foot note page 68, "In case of 4 or more longitudinal sills." if the labor cost would exceed 10 per cent. of the cost price of the body of the car, you would make it under 120; if not it would come under Rule 42.

Mr. Kipp: The question is if the sills were decayed and cracked, would he put both of these conditions down on the card, or would he only say that the sills were decayed and leave off the cracked?

Voice: Are any of the points using the form for transfers prescribed by the rule?

Mr. Abbott: It is used at Detroit.

St. Louis answered in the affirmative.

Cleveland: We use a bad order transfer card.

Cleveland, Cincinnati and Buffalo answered in the affirmative.

President Hanson: Is there any place that is not using that?

(No response.)

Mr. Schultz: I would like to know what the understanding is at the bottom of page 223, whether it is used on bad order?

Mr. Boutet: Cincinnati is using that for switching service.

President Hanson: You do not use that on cars that go out on the road.

Mr. Campbell: We are getting cars with these cards from Chicago clear up to St. Paul.

President Hanson: That might not be due to any fault of the car department. I think all railroads have that same experience. I know we have cases referred to our office quite frequently where a car has arrived at its destination with a bad order return card and they send the card to our office and want to know what to do with it. Those are caused by the transportation department failing to switch the car in accordance with the carding.

Mr. Eubanks: The people in our section make the contention that Mr. Schultz is asking that it be put on a car and allowed to stay on regardless of where it was going, and in addition to that, they require, before they take the car back, that we notify them of the condition of the car when we accepted it. I do not see anywhere in the rules that we are required to give them any notice, and I am satisfied that the cards are not for any other purpose than in and around the switching district. What I would like to know is whether or not, if this card did remain on the car, are we compelled to notify them, or give them our inspection in regard to the car at the time we received it in order to enable us to demand that they take that car back on the same condition that we received it in.

Mr. Schultz: I claim that the L. & N. are strictly within their rights. It is a good practice, if you allow a car to leave your terminal, to protect it from being reloaded at way stations with high class commodities. It is beneficial to the handling line to keep such cars out of service. The intention is to permit the car to go to destination, be unloaded and then returned to the delivering line, this card to be notice to the delivering line of the condition in which it was received. The very fact that you have a bad order record against the car does not keep it from being reloaded. This is the only way to protect yourself. Such roads as have used it have been able to keep the cars from being reloaded. If the rule is followed you are obliged to tell the delivering line in what condition you received the car in order to take it up.

President Hanson: Instead of confining the car to the switching district, the car should be allowed to go to its destination. It would indicate that the car should not be reloaded but returned and the receiving line asked for the record of the car when it was received from them. You should show them the record of the car at that time.

Mr. Schultz: Unless you control this bad order car the mechanical department loses control of it; it is reloaded and transferred and you will be criticised by the management for its being reloaded. It compels them to unload the car when they receive it unless you take advantage of this card. The interpretation that permitted the return of this car has been so broadened that cars are being emptied and upon the original record, taken back.

Mr. Carney: I do not believe that is good practice. Nobody wants to run cars with bad order cards. We do not want to keep the cars on the line. The foreman at the point where such cars are received sends in a report that a car is loaded for such a point with certain defects. We immediately take that up with the car owner and ask him to have that car returned to that point and also send a copy to them. We remove the card at that time.

Mr. Stoll: The rule nevertheless says that the previous delivering company has the right to demand that in returning the empty car, it must be placed on the car. If you turn to page 8 you will find it in next to the last paragraph.

Mr. Lynch: I think Mr. Schultz's practice is entirely at variance with the rule.

Mr. Schultz: It is not my practice at all.

Voice: If it wasn't your practice, there wouldn't be so many cars running around the country Mr. Schultz is trying to get something into the rules that is not good practice and advertises the fact that they are in bad order. I think it is not the practice. No railroad companies are desirous of running cars in that condition.

Mr. Schultz: I do not believe that any railroad company desires to do so, but the fact is that they are. We haven't any cars, but we have tried to suggest what is the practical way to control the bad order car. There are too many transfers. We get it in our heads to load a car and put in a high class load and offer it to somebody else to be unloaded. This is the way to control the car or transfer.

Voice: Is it the understanding that this card as shown on page 223 and so on be confined to the switching or yard district, or is it to be used to load a car to run to destination?

Mr. Campbell: I believe it would be good practice if the cars only went a short distance, but we have cars coming out of Chicago, going to Seattle, and we have to transfer them; they are unsafe to go to destination.

Mr. Schultz: There is the car that we should have transferred, but they take it upon themselves to run it in bad order. If unloaded at a local station where there is no mechanical supervision, a load may be put in the car.

Mr. Eubanks: I move that it is the sense of this body that we go on record as accepting the interpretation on page 7 of this book which reads: "When load is destined to a point inside of switching district and is not transferred, the car may be returned when empty to the delivering line, properly side-carded with a bad order return when empty card, etc."

Seconded.

Mr. Stoll: What are we going to do with the paragraph on page 8?

Mr. O'Donnell: I think Mr. Stoll will concede that Mr. Schultze and some of his assistants in the West are trying to save a little money for the delivering line. Mr. Campbell has to give it away the same as we do for their negligence. Any car that ordinarily ought to be transferred it is up to them to transfer when they inspect it and deliver it. I do not think our superior officers want to advertise the fact that we are carrying cars around the country on cardboards. They should be transferred at interchange.

The motion was carried.

President Hanson: While we are talking about bad order cars running around the country, I found a little piece of poetry that I would like to have read.

THE LAMENT OF THE FOREIGN BAD-ORDER EMPTY CAR.

No one seems to care
  How many moves I make:
No one seems to worry
  At the circuitous routes I take.
No one sees me moving
  From Maine to Californ—
Anw I get so tired and weary
  I wish I never was born.
No one wants to fix me,
  No one will spend a cent
To put me in good condition
  So I can earn the rent.
My owner will pay the money,
  As soon as the work is done,
As soon as I'm fixed and ready
  To go out on the road and run.

But it's always the same old story,
  As I wander from road to road,
In search of a friendly fellow,
  Who'll fix me up for a load.
"There's nothing allowed to repair you,"
  Is all they say at each place,
"We need all the money allowed us,
  To keep our own cars in the race."
And so I just wander and wander,
  O'er the face of the whole country wide
With a "Bad Order—Return When Empty"
  Carding upon my side.
Somebody ought to fix me,
  I don't want to roam,
So if you can't spare the mnocy,
  Please, sir, please send me home.

Mr. Lynch: Who is the author of that?

President Hanson: I think, Mr. Taylor, I got it out of one of the papers.

Mr. Lynch: It is so rich and timely that I would move you that it be spread on the minutes of the meeting and published with our report.

Mr. Schultz: The little poem expresses the condition exactly as it is. I think there is hardly a man in the room but who hates to repair a foreign car, if he would say just what he feels. And it is surprising to know further that as the M. C. B. rules are today, you can take any man's car into the shop and bill and he is willing and able to pay for the work, but regardless of that it is not being done. The condition of present equipment is due to that very fact, that no one wants to repair a foreign car. There will be four cars on a track, three of them owner's and the fourth one gets a lick and a promise.

RULE 234.

Mr. Elliott: It seems to me that that is out of harmony in a way with some of the transportation officials. Here a few weeks ago they promulgated that 24 hour transfer rule. Undoubtedly they are going to insist upon special agreements. We are not working in harmony with the transportation officials. They are our superiors and they are going to insist that we work according to their ideas.

Mr. McMunn: The arbitration committee has worked harmoniously with the American Railway Association and I do not see how we are going to get out of harmony with them. As a general proposition this rule should be put into effect at all interchange points, but let it be understood that any action we may take here is not mandatory. It is simply the opinion of this body that it is advisable that the provisions of the rule be complied with.

Mr. Elliott: This is a deplorable condition. As a rule the chief interchange inspectors are under the transportation official jurisdiction. In their meeting in San Francisco they adopted the 24 hour transfer rule, and they are going to insist that Mr. Schultz and Mr. Hanson when they go back work in accordance with it.

Mr. Schultz: As I said yesterday, for once we have what we can safely say is a universal transfer rule approved by the Master Car Builders and the American Railway Association, and I am sure it is their intention that these rules be carried out October 1st. I hope that for once we will make up our minds to carry out the transfer rules uniformly throughout the United States. There are no conditions to my mind under which these rules cannot be properly worked.

Mr. Campbell: I think, Mr Schultz, we have a special agreement similar to Chicago and we are going to recommend that the M C. B. rules as written be carried out and our special agreements will be so modified.

Mr. Boutet: It is my understanding that this rule provides for transfer as under Section F. If we have a car of earthenware and the repairs necessitate the splicing of two drawsills, we know if we transfer that car we have more damage to pay for the transfer of the freight than all the company gets out of it for freight. If there is no objection, under this rule we can go as far as we like, if we can avoid transfer. The rule says that we shall not transfer a car with certain defects, if we want to repair. I do not think there is any objection to the rule by the transportation department.

Mr. McMunn: I would like to take issue with Mr. Boutet so far as the statement he made that cars cannot be transferred. It simply means that you may transfer a car if you like but if you do so, it will be at your own expense. The rule says that repairs to cars with such defects can be made under load. If you transfer a car to make such repairs it will be at the receiving line's expense.

Mr. Boutet: I meant that no transfer order would be given against the delivering line for any defects as are enumerated here. If the receiving line wants to transfer the car it can transfer it for a slid flat wheel at their own expense.

Mr. Abbott: We have the 24 hour transfer rule. If my rip track is in a condition that I cannot handle cars and they have to lay over 24 hours, they are transferred.

Mr. O'Donnell: I was going to ask if you got money from the other fellow?

Answer: No, sir.

Mr. O'Donnell: Transfer everything you want to.

President Hanson: We will now proceed with the Passenger Rules.

RULE 1, Paragraph D.

Mr. McMunn: Paragraph D was added to that rule to get it away from paragraph C, which covers line expense items. This covers owner's responsibility. They just added an additional paragraph so as to take it from line expense items.

The following letter was received from Mr. Trapnell:

Kansas City, Mo., Sept. 11th, 1915.

Mr. F. H. Hanson, Pres. C. I. C. I. & C. F. Assn.,
  Murphy House, Richmond, Va..

Greetings to all the Members:

Being unable to attend this, the 17th Annual Convention, on account of circumstances over which I had no control, I take this method of wishing

you all a good convention and a thorough discussion of the changes in the Rules, and I await with pleasure the publication of the minutes of same.

I desire to call your attention to a few of the changes: Rule 33. The question has been raised a great many times that defect card can be issued for bad order safety appliances, as follows: A car has been struck on the end, bending the end grab iron and the handling line made an effort to straighten same with a bar, but when the car arrives home the owner desires to properly straighten this grab iron and have to R. & R. the same. Would it be proper in line with Circular No. 9, to give the owner defect card to cover, knowing that the necessary two-inch clearance was there before removal.

I would suggest that a specific amount of time be given on the transfer as the method now prescribed in the new Rule No. 2 will cause more or less dissatisfaction, with a specific time stated for which repairs can be made and an exception to steel bolsters, if thought necessary, would help the Rule and make it less liable to be misunderstood.

Foot note to Rule 42 does not say who shall jointly inspect car for the owner. I would suggest that more safeguard be thrown around this rule as at large interchange points only the Chief Interchange Inspector or his assistants be authorized to sign, as this rule is badly abused in some instances where the Chief Interchange Inspector has refused to sign for damage to charge the car owner. The inspectors on the interchange track have been induced to sign satement just to be a good fellow. At out side points the foreman of a disinterested line can be requested to represent the car owner, and then I believe less sharp practice will be the result and the car owner will feel he has had a square deal. I believe this cannot be urged too strong in the convention.

Rule 120. This rule is plain as far as it goes, but in reporting a car in a general worn out condition as prescribed by this rule, could the sills enuemrated in the foot note to Rule 42 be included as the decay to the sills is in a large majority of the cases is the primary cause for sills of this character, cracking as the inside of the shell of the sill is full of junk and therefore no strength to the sill.

My kindest regards to all the officers and members and to Mr. Kipp, the incoming President and to Mr. Skidmore the Secretary, who I hope will be still found at his old post. Also to T. J. O'Donnell, ever ready spokesman on all occasions.

I wish you a pleasant and profitable session and that much good will be accomplished, and it would indeed have been a pleasure to have met all the members and taken part in their discussion.

Mrs. Trapnell and daughter join me in wishing you all a grand and good meeting and plenty of enjoyment.

Sincerely and truly yours,
F. W. Trapnell, Chief Interchange Inspector.

Mr. Boutet: I move that the paper be received and that the secretary be instructed to telegraph Mr. Trapnell and tell him that we will consider the suggestions he offered and how we regret his absence at this convention, with his very valuable interpretations of the rules.

Seconded and carried.

Mr. Ratcliff: I would like to hear a discussion under Rule 43 and get the opinion of the association at this time. The main question in my mind on this rule is on the subject of damage to the upper frame of the car. The rule says the under frame. I want the opinion as to subsequent damages to the upper frame.

Mr. Stanson: There is a decision on that, deciding on the upper structure, in the case that the Frisco had. They wanted to cover all the damage under 43 and the committee decided that all damage to the upper structure will have to be repaired.

Mr. Schultz: It should not be a handling line defect. If there is any damage to the under frame, as provided in Rule 43, resulting in damage to the upper structure, it is all owner's defect. This refers particularly to the under frame.

President Hanson: You feel that if you have a weak under frame due to corrosion, and due to the weak condition of the under frame the upper structure was damaged, that you should have joint inspection made and submitted?

Mr. Schultz: It is car owner's defect.

Mr. Carr: Follow Rule 48. It says failure or loss under fair usage of any part of the body of the car.

Mr. Monahan: How about Rule 42, which says this will include damage to upper part?

Mr. Vittim: If you will refer to arbitration case No. 997 you will see that in that case the under frame of the car gave way. The damage was assessed against the owner, but in the giving way of the under frame there were broken the four posts, which is covered by Rule 42, and the Arbitration Committee holds that as far as the damage to the under frame is concerned the owner shall be responsible, but as far as the damage to the upper structure, which is fully covered by Rule 42, then the handling line shall be responsible. But the question goes beyond that: If there should be damage to other parts of the car, such as breaking of side boards, where the damage to the steel under frame by bending or springing does damage to other parts of the car, which are not covered by rule, who is going to be responsible for the other parts of the car?

Mr. Carr: In regard to a combination, you have a composite car that would not come within the combinations. You do not get a combination on a hopper car, but you get a combination on a steel car where the superstructure is involved.

Arbitration decision No. 997 was read.

Mr. Ratcliff: I had in mind an all-steel car. The tendency is to buckle and the whole structure is damaged if a center sill gives way behind the bolster.

Mr. Pendleton: It is made plain in Rule 43 that it is owner's responsibility. If you buckle a car it will all be owner's responsibility, unless the car was in a derailment, sideswiped or an accident. A steel under frame car, with a wooden upper structure—if you break both of the side plates by buckling—would also be car owner's responsibility.

Mr. Monahan: Rule 43 only mentions the under frame. There is a question there for somebody.

Mr. Pendleton: The Arbitration Committee has ruled that the handling line is responsible only when a combination is involved, they say, on the end of the car. In the absence of a combination, it is entirely owner's responsibility. If they form a combination they handle them at delivering company's responsibility.

Mr. Carr: It is our understanding in connection with a steel under frame car, with wooden upper structure, that the failure of a center sill from buckling is owner's defect, and, according to the rules here, it is the same thing. That is a failure under fair usage. The car was too weak. I would like to have a ruling in regard to both of them.

Mr. Elliott: Mr. Pendleton voiced my sentiments.

President Hanson: Is it the custom, when they get an all steel car, to hold that car and take it up with the owner and ask him to make an inspection and decide how far you can go in billing the owner?

Mr. Stroke: We have had several of these cases and called the owner for joint inspection, and in each case they took the car or gave us credit.

President Hanson: That has been our experience. We ask them to either send a representative or select some one in our territory to make a joint inspection for them.

Mr. Halbert: I handle it that way on a joint statement and refer it to the owners.

Mr. Dyer: It seems to me that it is clear that the responsibility is placed under Rule 43, in connection with Rule 48. Rule 43 places the responsibility for the damage to the under frame of all steel cars with the owner, and it then states in Rule 48 that failure or loss under fair usage of any part of the body of the car would be with the owner. If the responsibility for the damage to the under frame is with the owner, likewise the responsibility for the damage to the upper structure, through the failure of the under frame, must also be with the owner.

Mr. Armstrong: We have a case of that kind in our district and we are handling it on the same line as the gentleman who preceded me—under joint inspection, with report to the owner of the car.

President Hanson: That seems to be general throughout the country, so far as I know.

Mr. O'Donnell read the following telegram to be sent to Mr. Trapnell, which was signed by members of the executive committee and ordered to be sent.

Richmond, Va., September 15, 1915.

F. W. Trapnell.
Chief Interchange Inspector, Kansas City, Mo.

Entire membership in session sincerely regret your absence, realizing the great work performed through your personal efforts at past conventions for the welfare of Interchange. Greetings from membership to yourself and family.

S. Skidmore, Secretary.

And thereupon the convention adjourned to meet at 9 o'clock Thursday morning.

THURSDAY MORNING SESSION.

President Hanson: I have been informed that there are several who are planning to leave at noon, and it has been suggested that we proceed to the election of officers at this time and defer further discussion on the rules until after the election.

Mr. Schultz: I am one of the members that has to leave and I would move you that we proceed to the election of officers.

President Hanson: There are several rules that we will refer to, and we may have time to clean up everything and get out of here by 12 o'clock.

Motion sconded and carried.

The following telegram was read and received.

Winston-Salem, N. C., September 15, 1915.

J. E. McCormick,
Care Hotel Murphy, Richmond, Va.

Your kind invitation to attend meeting Car Inspectors and Foremen's Association just reached me North Wilkesbarre, N. C., today. Owing to meeting at Greensboro, of which you are aware, I will be deprived of the pleasure of meeting with you and the other co-workers. I wish for you and all a most successful meeting. If there is anything Southern Railway can do to add to the enjoyment of the association while in Richmond command my office, fourth floor, Times Building.

R. E. Simpson, Gen. Supt. Southern Railroad.

On motion, the secretary was authorized to send a reply to Mr. Simpson, thanking him for the courtesy and assuring him of the appreciation of the association.

President Hanson: I have been informed that our secretary declines to be renominated——a fact I very much regret. So it will be necessary to elect a new secretary and treasurer and members of the executive committee to take the places of W. R. McMunn, C. J. Stroke, J. J. Devaney and C. W. Maddox.

ELECTION OF OFFICERS.

Mr. Elliott: In accordance with our usual custom, I will place in nomination for the office of president of this association our present vice-president, Mr. A. Kipp, general car inspector of the New York, Ontario & Western at Middleton, N. Y.

Seconded by many.

On motion of Mr. Lynch, duly carried, the nominations were closed, and Mr. O'Donnell was instructed to cast the vote of the association for Mr. Kipp.

Mr. O'Donnell: I have the extreme honor, and pleasure as well, being an old acquaintance of Mr. Kipp, in declaring him your choice for president for the year 1916. He is general inspector for the New York, Ontario & Western at Middleton, New York, and always on the job. (Applause.)

President Kipp: I am afraid I will have to disappoint you in that speech you expect me to make. I was neither educated an orator, nor did it come to me by birth; but one of the things I do wish to say to you is this, that the honor you have just bestowed upon me I appreciate very much, and I wish to thank you all individually. I shall try to do the best I can during the term of my office, and I hope that each and every member of the association will give me his hearty support in the future, as you all well know that 'divided we fall, united we stand.' I thank you. (Applause.)

Mr. Schultz: For vice-president, I take pleasure in nominating my friend from Toledo, Mr. W. J. Stoll.

On motion of Mr. Gainey, the nominations were closed and the secretary instructed to cast the ballot of the association for Mr. Stoll, which was accordingly done, and Mr. Stoll was duly declared elected.

Mr. Stoll: I am like my friend, Kipp, I am not a born orator, but I will do the best I can and I thank you for the honor.

For secretary the name Mr. Skidmore was placed in nomination.

Mr. Skidmore: Before the nominations are continued, I wish to make a few remarks to the members and officers of this association in regard to my nomination. I positively decline to accept the nomination, and with the very good reason that there is more work connected with the association that I have the time to devote to it properly. For that reason I could not accept it any longer under any consideration. Last year I thought I would keep record of the number of pieces of mail I sent out, and from the last meeting to this I sent out 1,703 pieces of mail. As my time is occupied throughout the day and I have to devote Sundays and evenings to the work, I think it would be a hardship for me to think of doing anything of that kind again. I have always the welfare of the association at heart, and I have always done the best I could toward the upbuilding of the association. Whoever my successor may be in office—I want to say to him and to the members of the association, if there is anything in the world that I can do at any time to assist him, I will be only too glad and willing to do it. It does not make any difference who is elected, that offer is good to him, and I want him to feel at liberty at any time to call upon me.

President Hanson: I might say that I received a communication from Mr. Skidmore a couple of weeks ago, and he told me at that time that it would be simply impossible for him to think of holding the office any longer. I am satisfied that if he had been willing he would have been elected.

Mr. O'Donnell: While the question is open for nominations, I ask the honor and pleasure of requesting the association through our president, or executive committee, to extend the same courtesy in the line of a memento that we do to our presidents, for the services rendered by Mr. Skidmore.

Carried.

The name of Henry Boutet and the name of W. R. McMunn were placed in nomination for secretary and treasurer.

The ballot resulted as follows: For Mr. McMunn, 71 votes; for Mr. Boutet, 65.

On motion of Mr. Boutet, the election of Mr. McMunn was dechred unanimous.

Mr. O'Donnell: Speaking on the question, I think the vote is an honor to this association and to the two men. Four votes would have thrown it either way. I trust there is no sting for either one and that we will go along in the good old way.

A. KIPP
President for 1916

The following members were placed in nomination for members of the executive committee: A. Armstrong, Z. B. Wilson, J. H. Forest, W. M. Halbert, C. W. Mattox, J. H. Forest and C. J. Stroke.

The ballot resulted as follows: Z. B. Wilson, 121 votes; C. Maddox, 101 votes; A. Armstrong, 94 votes; C. J. Stroke, 92 votes; W. M. Halbert, 83 votes; J. H. Forest, 41 votes.

Messrs. Wilson, Armstrong, Mattox and Stroke were declared elected members of the executive committee for the term of two years, and Mr. Halbert for the term of one year.

Mr. Wilson: I appreciate very much the recognition give i the Southern district. I am located at Knoxville, within easy reach of good men. I will put in my best efforts in connection going to tell you what I repre- with the work and will do all I can to increase the membershipby the next meeting.

Mr. Armstrong: I am not going to tell you what I represent, not that I am ashamed, but I do not want to take up your time. I want to say that this has been my maiden convention and I would rather prove up by my works what I am able to do than to talk to you at this time.

Mr. Maddox: I am sorry that I have not done more in the past year than I have, but I have been very busy and unable to attend the meeting of the executive committee at Chicago. I certainly hope to be able to do more in the coming year. I promise to do the very best I can as a member of the committee. I thank you very much.

Mr. Stroke: I am not an orator and do not intend to make a speech, but I will thank you for returning me to the executive committee, and I will certainly do all in my power to get the association to the front and make it one of the best organizations in the country.

President Hanson: It is now in order to have some remarks from Mr. Wright.

Mr. Wright: The usual custom is to read the names of those who contributed. You will understand that the contributions made are simply donated. We have no organization. We appeal to the people who are interested and would have a desire to help entertain you, and from them comes our support. I will read the names:

W. P. Murphy & Co., Union Draft Gear Co., W. H. Miner Co., National Malleable Castings Co., Westinghouse Air Brake Co., Pyle National Electric Headlight Co., Gold Car Heating and Lighting Co., Universal Draft Gear Co., Standard Heat and Ventilating Co., the Joyce Gridland Co., Hale & Kilburn Co., the Q. & C. Co., Boss Nut Co., Grip Nut Co., American Brakeshoe and Foundry Co., McCord & Co., Standard Paint Co., Scullin Steel Co., McConway Torley Co., Camel Co., Galena Signal Oil Co., United States Metal Manufacturing Co., Duff Manufacturing Co., Chicago-Cleveland Car Roof Co., A. O. Norton Co., Ajax Metal Co., Curtain Supply Co., the Bettendorf Co., American Steel Foundries Co.

We have been very much encouraged, and it should be doubly encouraging to you. The feeling expressed by the people who contribute toward the entertainment is the expression of their feeling toward the strength of this association and we think you sbould be very much encouraged.

I do not think it is necessary at this time to make any remarks witb reference to the treatment we have received in Richmond. It may be just the course of events, it may be something else, but each year we feel that we have been treated better than we were the previous year, regardless of where we have been. I think the remarks I made last year tbat the entertainment work was laid out for us better than any place else would apply now, as we have had more assistance bere than we ever had before. It may be the spirit in the location, and it may be just the natural progress. We certainly have had a lot of assistance here. I do not know of anything further. (Applause.)

Mr. O'Donnell: I move you that the report be accepted. The remarks of Mr. Wright are fully appreciated. I believe it is the custom to thank the entertainment committee publicly before we adjourn.

I would ask your pardon while I bring up at this time the fact that we have two master car builders on our rolls now. One of the good men has taken a great interest in this association and is a gentleman that I had the honor to be working for, and I would like full well, for a double purpose, that this association send a letter to Mr. J. W. Senger located at the Collingwood shops expressing our appreciation and hoping that he may continue with us in the future.

Carried.

President Hanson: On behalf of the association, members of the entertainment committee, I want to thank you for the splendid entertainment tbat you have provided for us this year, and we only regret that we were not able to belp you more. I believe we have had the time of our lives, so to speak. We feel that you have certainly done wonders in Richmond, and I take great pleasure in thanking you.

Mr. Wright: There were times during the early efforts of the entertainment committee when there were some discouraging spots, and very often we run into feeling here and there where we find we have not pleased everybody. I have learned in the past few years that we are not expected to please everybody, as they are not all of the same mind. In fact the entertainment committee themselves are not all of the same mind, but when we are all through, the expressions of appreciation from the association take away all the ill-feeling and the hard work is forgotten. I enjoy it just as much as you do. (Applause.)

Mr. Pendleton: This association appreciates fully everything that the entertainment committee has done, and I feel that a suitable committee should be appointed to draft resolutions.

Messrs. Pendleton, Forest and O'Donnell were requested to draft suitable resolutions.

Mr. Boutet: I would like to see the association take some action on the paper that I presented. It is one of the most serious problems that we have.

Mr. Keene: This paper is one of the best I have ever heard. It pertains to the large interchange points. You all know at these points the chief interchange inspectors are the judges. Every one of them will look at this matter in the way Mr. Boutet has. If they get together the trouble now existing on the carding of defects will be eliminated. At the small points we do not have much trouble because as a rule two men can get together better than a dozen. I believe that a good deal of it is up to the chief interchange inspectors.

Mr. Boutet: That is what I realize. I am glad to have the gentleman speak the way he did. The little fellows can get together and they do not have so much trouble. They do not have so many cars to interchange. Let us try to start out with the new rules, cutting out trifling defects.

Mr. Armstrong: I am heartily in accord with the idea evolved in Mr. Boutet's letter and representing ten roads I am going from this convention to my home with the avowed intention of doing everything possible to carry out the ideas expressed.

Mr. Forest: For my part I do not see wherein any one could take any exceptions to that letter. While I haven't very many inspectors under my charge, I have a few, and I, for one, will try to carry out the spirit of Mr. Boutet's letter.

Mr. Gainey: I would like to say in behalf of Mr. Boutet, the reason he gets away from a great deal of this carding, at Cincinnati each foreman has charge of his own inspectors. They all use the Chief Joint Inspector's (Mr. Boutet's) card. He has a school once a month. The inspectors for all roads meet in the night time between 8 and 10 and ask questions. Each foreman requires his inspectors to be there. That way they get a uniform carding. Night inspectors meet from 8 to 10 in the morning and be does likewise with them. In these meetings all the foremen of the different roads sit there with Mr. Boutet. They ask questions and he answers all questions. For that reason at Cincinnati they get uniform inspection.

Mr. O'Donnell: I think every person here who has listened to the able paper of Mr. Boutet's fully appreciates that it is the ambition of all to keep down the defect carding as much as possible, but there are certain conditions in certain sections where you cannot do as you would like.

I move you that it is the sense of this association that the paper be received and contents fully considered and that we carry out as far as possible the expressions of Mr. Boutet.

Carried.

Mr. O'Donnell: Will you kindly permit me to put before this body a suggestion that is in my mind—that is that our Executive Committee contain one member who is a representative of private lines. We have here a number of these representatives, and they are as keen for the welfare of the equipment as we railroad men. I believe it would have a tendency to cement together for the best interests of interchange. I suppose we would have to change our constitution, but next year I would ask that it be considered.

President Hanson: This has been given consideration. A great many other changes will be necessary in the constitution to bring them up to date. The constitution and by-laws were written several years ago, and have not been kept up. For that reason it will be necessary to have them revised.

Mr. Gainey: Very unfortunately for me, since this meeting started I have been under the weather, and unable to participate very much in the discussions; but I quite agree with Mr. Hennessey in his remarks in that letter. Since the foot note of Rule 42 and Rule 120 went into effect it has been misused by a great many people throughout the country. I do not say that it has been misused by the Chief Joint inspectors or the car foremen of this association, but by the people who do not belong to this organization. A case may be written up on Rule 120, and when you go and look up the car there is no comparison between the statements and the condition of the car. I have made it a practice to go and inspect every car that is written up under this rule. I have found nothing wrong where the chief joint inspector or one of his men has signed this certificate, but there are other places in the country where these men are under the impression that if they write a car up under Rule 120 it is to write it up to be destroyed. A man wrote a car up and said that all he could use on this car was a couple of body bolsters or trucks and a coupler. I went and inspected the car and it needed 4 sills, 15 feet of siding and 4 draft timbers. The rest of the car was in first class condition. If this thing is going to continue throughout the country, where are we going to stop? I think every man at this convention should take it up with his men and see that the actual condition of that car is placed on the certificate. If it isn't I think on the 1st of October, when these rules go into effect, it should be written up, and in that way stop this kind of work.

I want to say also on the foot note of 42 in connection with Rule 120 that a great many forget to write a car up when it goes over 10 per cent. You take a 34 ft. car, 360—$36.00 limit is as high as you can go. If you go over I am of the opinion that the owner of the car can turn that bill down because you have not complied with Rule 120. There may be some arbitration case on that. I would not be disposed to turn it down. We had a 34 ft. car that a railroad repaired. It ran $2.81 over the limit of the foot note. They had a kick coming that they did not write it up and give us a chance to inspect the car.

President Hanson: The paper has been received. It seems the sense of this meeting that we agree with Mr. Hennessey, and we positively will state that when we go home we will not ask for or sign joint evidence, except the car be inspected, as we understand joint evidence. That is, we will not write up joint evidence and call a neighbor up and ask him to sign the statement.

Mr. Boutet: I believe this association should go on record in every possible shape to say that we are unanimously in favor of carrying out the intent of the Master Car Builders rules, and I would ask for a rising vote on the question.

Mr. Lindman: Isn't that motion out of order. The rule strictly says that we must make joint inspection.

President Hanson: I consider Mr. Hennessey's remarks very proper. He has called to our attention a very important point. It goes to show what the arbitration committee are up against.

Mr. O'Donnell: I do not like to condemn our own past life in passing the motion. I think Mr. Hennessey's suggestion was not a charge against any member of the association It It was something local. My thought is that in reply to Mr. Hennessey we simply say that any chief inspector, or foreman, or single inspector—his sense of honor would compel him to see the parts personally and sign them before he would let that kind of work go floating around the country.

Mr. Eubanks: Mr. O'Donnell must have been doing something wrong. Mr. Gainey says he has been under the weather and hadn't been talking much. I am satisfied that if the convention lasts long enough he will make it up. It seems to have been Mr. Boutet's idea that we would encourage this practice, but I think all he wants is that we do right.

Mr. Boutet: My object is to say to the arbitrating committee that this association is not going to leave a stone unturned to carry out the rules as prescribed by the Master Car Builders, and that we will positively not sign any joint evidence nor ask anybody else to sign unless we make a personal inspection of the car.

The motion was carried unanimously.

President Hanson: We have a paper presented by Mr. Lynch on the wheel question. The point brought up was the change of our standard wheel and coupler gauge. As we know any changes will be taken up in January or February, and as Mr. Lynch's paper was read yesterday, the matter should be given consideration at our next meeting of the executive committee, and it can then be decided whether we were justified in asking for any change or not.

Mr. O'Donnell: I think Mr. Lynch brought that up three years ago.

Mr. Lynch: I wrote the chairman of the wheel committee on the question and got no reply. I still feel that there is a point there.

Mr. McMunn: I move you that the report of Mr. Lynch be received and that it be referred to the executive committee for such action as they deem proper, and that the different members look into the matter during the year.

Seconded and carried.

President Hanson: In regard to the change of by-laws. Has any one anything they would like to suggest at the present time?

Mr. O'Donnell: In regard to the letter from Mr. Schaff, I think our president should express our appreciation when he gets back home. The words expressed in that communication are more or less in line with the spirit that seems to be assisting our membership. The operating officials are keenly watching our movements.

Mr. Elliott: We have various local associations, and it was my idea to combine these associations in a way as far as the proceedings were concerned to make it as far as possible more universal. I have talked to the gentlemen about it and I believe it is a good thing. It will enlarge the prestige of this organization, because from month to month we will have something to keep in mind, for the coming meeting. It would give us an opportunity to meet with the transportation men. They are the men who are demanding things of us, and we have got to do these things or explain to them why we do not. I believe it gives us a better understanding of the rules as far as they have to do with the entire railroad. These local organizations are nearly all composed of transportation men.

Mr. O'Donnell: I move you that it is the sense of this body that the communication of Mr. Elliott be received: that the President be empowered to appoint a special committee with a view to getting the members from each of the points where one of these associations exists: that this committee report back to our executive committee before our next meeting.

Seconded and carried.

Mr. Carr: In going over the rules yesterday Rule 98 was not given any consideration. If you are aware the introduction of steel wheels under our freight equipment is becoming more general than it has been, especially in the heavy class of cars. On the last part of Rule 98 I would like to get an interpretation of the rule.

Mr. Elliott: I read the rule when it was first put in the book. I have not had any case under it, but it seems to me to be very plain.

Mr. Carr: How do you measure it from the condemning limit?

Mr. Elliott: I have not had a case, but I suppose I would caliper the wheel, the same as anybody else.

Mr. Carr: Is there anything that shows you how to measure?

Answer: There is only one practical way to measure. Measure before you turn them off and measure them after you turn them off. I would gauge them with a pair of inside calipers.

Voice: At my point I removed the steel wheels and applied a pair of cast wheels. The wheels came back to me and they were reapplied, and I believe if I had them to handle I would have to do the same. Figure it out when the wheel was returned.

President Hanson: That is a shop practice. We had a gauge made that our foreman uses for condemning wheels whether the tires were returned or not. I cannot say yhat the practice is in the other parts of the country.

Mr. Carr: I am trying to get at how you interpret it. Where do you get the interpretation from? You have nothing in the book of rules to show you anything in regard to this rule. It says ¼ in. above the limit. There are men measuring that ¼ inch above that, and when you come to settle the bill you have ¼ inch difference in the metal, and if you look at the measure limit given on page 271 that is a steel wheel that shows you an irregular triangle: that is according to M. C. B. rules. You will find that it was made with a nosing tool. If the wheel is heavier on one side the tool goes in deep. One man gauges on the light side and the other on the other side, and you have a difference of 1/16 inch.

Mr. Elliott: We do turn lots of wheels in the shop. They are passenger wheels. You would have to find the area of the wheel and divide by the difference in the measurements. I would measure four points and arrive at what would be the practical size of that wheel.

Mr. Ratcliff: The M. C. B. drawings and specifications for wrought steel wheels call for the witness groove to be ¾ inch outside the inner edge of the rim, and it is our practice to measure the distance from the base line of the tread to the inside of the rim with a right angle gauge and deduct 1 inch from this measurement. This method eliminates the uncertainty due to variations in the witness groove and gives the exact amount of service metal outside the condemning limit, which is ¼ inch outside the witness groove.

Mr. O'Donnell: This association does not follow up the technical part of turning up steel wheels. If any of us have overlooked that fact it is up to us to find out what we are doing.

Mr. Carr: This is a car foreman's meeting and there are car foremen present. They can give it. The thing is to get it correct. A great many are not using steel wheels, but as the heavier equipment goes into service these measurements will have to be understood.

Mr. Ward: Mr. Ratcliff has explained fully the method of handling the matter on the C. & O.

Mr. O'Donnell: Is that a fair way?

Mr. Gainey: I think Mr. Ratcliff is right in his measurements. If we all follow out what he has explained I think we will come out all right.

Mr. Carr: I would like to ask the gentemen if the groove is made with the nosing tool.

Mr. Ratcliff: It does not make any difference how it is made. The specification and cut of the wheel shows the witness groove ¾ inch outside the inner edge of the rim. If you will deduct the measure that you will get from the float of the measure, it will undoubtedly give you ¼ of an inch, if the witness groove was put in there in accordance with the drawing.

Mr. Carr: I would like to find out if the witness groove is put in in accordance with the drawing, how you can get a regular line from a nosing tool when the wheel is laid on a table and bored for a wheel fit. If the metal is heavy on one side it will go in so much deeper and the radius is so much less. If you take in the base line your measurement is out.

Mr. Ratcliff: I think it is up to the men buying steel wheels to see that the wheel maker puts the witness groove on according to the specifications.

Mr. Gainey: I would like to know from the shop men in particular how they handle splicing of center sills under Rule 22. The rule says the center sill must be spliced according to one rule. There were a great many sills spliced before this rule went into effect with the old style splice. A great many of these sills break ahead of the body bolster. Is it proper to splice back the same way as you took them down or is it wrong repairs. You do not touch the part that is left in there. It is not broken at the splice, but at the head of the body bolster.

Mr. Elliott: Some time ago we had that case come up. While we agreed that technically it was wrong repairs—if you splice it you are to splice it according to M. C. B. rules—but we agreed that where we found cars and the splice was in good condition on our own cars that we would renew that same splice if it was in good condition. But we agreed that it was wrong repairs if any one insisted on it.

Mr. Gainey: I have been making it a practice that when a car came into the shop and the splice was already in the sill we just got out a splice to fit that, but is the car owner going to turn you down?

Mr. Elliott: Under the rules he has a right to, but we had that splice for years and years, and we adopted a new splice because of its simplicity.

Mr. Pendleton: Are you talking about splicing wooden sills?

Answer: Yes.

Mr. Pendleton: Where would you put the butt splice in it? A man couldn't splice it with the butt splice according to the rule.

Mr. Forest: You cannot perpetuate wrong repairs from the fact that the splice was made prior to the forming of this rule.

Mr. Elliott: Mr. Gainey has said that he considered it a good practice to renew that splice. I would like an expression from the chief interchange inspectors as to whether they would sign joint evidence.

Mr. Eubanks: If I knew the conditions I wouldn't sign it.

NEXT MEETING PLACE.

Most urgent invitations were extended to the association for holding their next meeting from a number of cities, among them Peoria, Ill.; Buffalo, Cedar Point, Detroit, Memphis, Baltimore, Chicago, St. Louis.

The matter was left to the discretion of the executive committee.

The following letter was sent to Mr. Berg:

Richmond, Va., Sept. 16, 1915.

Mr. Albert Berg, General Foreman N. Y. C. R. R., Erie, Pa.

Dear Mr. Berg: This to acknowledge receipt of your generous communication addressed to our President, Mr. F. H. Hanson, under date of August 27, outlining your personal views of our good Chief Interchange Inspectors and Car Foremen's Association.

The communication was placed before the membership in session and the undersigned are happy to state that it brought out so much good feeling, and was received in such a spirit that it was the unanimous wish of the membership that the letter should be acknowledged immediately to yourself, conveying to yourself and your good helpmate, Mrs. Berg, the very kindest greetings of all the members and their families in session at the historical city in Virginia.

With sincere wishes for your future good health and happiness, and trusting you both may attend our future conventions, we beg to remain.

Very sincerely yours,

F. C. SCHULTZ.
W. J. STOLL.
J. P. CARNEY.
W. R. McMUNN.
C. J. STROKE.
C. W. MADDOX.

On motion the following resolutions were unanimously passed, and ordered to be spread upon the minutes:

Whereas, it has pleased Divine Providence to call from our midst our beloved comrade, George M. Bunting, and

Whereas, in the death of Brother Bunting our Association has lost an earnest and faithful co-worker and his family a devoted husband and loving father:

Be it Resolved, that the members of the Chief Interchange Car Inspectors & Car Foremen's Association, expressing our deepest sorrow at the loss of our friend and fellow worker, extend to the family of the deceased our heartfelt sympathy for the loss it has sustained, And

Be it Resolved that these resolutions be spread upon the minutes of the meeting, a copy sent for publication to the RAILWAY MASTER MECHANIC, and one to the family of the deceased.

GEORGE LYNCH.
JOE DYER.
W. J. FREY.
Detroit, Sept. 25. 1915.

Mr. Samuel Mann, Joint Interchange Inspector at Detroit, died Thursday, September 2, 1915, after a brief illness.

Mr. Mann was born in Hamilton, Ont., March 25, 1857, and entered the railway service at Port Huron, February 1, 1874, in the car department of the old Great Western Ry., which is now the Grand Trunk Ry.

Mr. Mann was in active service until August 28, 1915.

Whereas, in view of the loss we have sustained by the decease of our friend and associate, Mr. Mann, and of the still heavier loss sustained by those who were nearest and nearest to him, therefore be it

Resolved, that it is but a just tribute to the memory of the departed to say that in regretting his removal from our midst, we mourn for one who was in every way worthy of our respect and regard.

Resolved, that we sincerely condole with the family of the deceased on the dispensation with which it has pleased divine providence to afflict them, and commend them for consolation to him who orders all things for the best and whose chastisements are meant in mercy.

Resolved, that this heartfelt testimonial of our sympathy and sorrow be forwarded to the family of our departed friend by the secretary of the meeting.

(Signed)
J. P. CARNEY.
C. E. BURGESS.
WM. MELMS.

Resolutions on the death of Mr. F. N. Shuler, for the Chief Interchange Inspectors and Car Foremen's Association:

WHEREAS, It has been the wish of the Almighty in His wisdom to take from our midst our coworker and esteemed brother member, Mr. F. N. Shuler, general car foreman of the New York Central at Auburn, N. Y., deceased July 24th, 1915:

WHEREAS, In the death of Mr. Shuler the association has lost one of its most active members, who has always taken a keen interest in the welfare of the association by securing many new members and attending many conventions for years past;

Resolved, That suitable action be taken on the death of Mr. Shuler, that the resolutions be spread in our minutes, printed in our official paper and a copy sent to the home of the family of the deceased.

Mr. F. N. Shuler entered the employment of the old Fall Brook Railway Co. in the year 1883, starting in the ranks as a repairer and carpenter, and remained in service up to 1900 at Lyons, N. Y., was always a valuable servant of the company; promoted to foreman of the New York Central at Auburn May 1st, 1907, and had given valuable services as such up to the time of his death, and was highly respected by his superiors and those with whom he came in contact.

C. J. STROKE,
W. F. TYLER,
J. C. SCOTT.

Mr. O'Donnell, Chairman of the Committee on Resolutions, reported as follows:

The thanks of our association are especially due to the City of Richmond for the excellent and beautiful streets and to Mayor Ainslie for the cordial manner in which he has opened the city to us during our convention.

To the Murphy Hotel is due our thanks. From bell boy to president we have received the most courteous treatment. Every wish has been gratified

by the management of the Hotel Murphy. We shall return to our respective homes always remembering the kindnesses received, and send back to the city of Richmond as many conventions as we can.

To the railroads centering at this great city we extend our most cordial thanks, especially the C. & O., and its esteemed Superintendent of Motive Power, Mr. Gould, and our own Mr. Maddox, and to Mr. Roberts, who came here to furnish transportation for the members and their families. The railroads have been very generous with us.

To the press of Richmond we extend our thanks. They have been most generous with their kind words for us.

I wish to second the remarks of our President to the members of the entertainment committee. They have done most nobly on this occasion, as they have on many occasions. To Mr. Wright and his assistants we most cordially extend our thanks; to the exhibitors who have favored us with the display of their wares; to our esteemed President for his most excellent methods of taking care of the convention while the temperature has ranged from 98 to 120 degrees. Those of us who worked with Mr. Hanson know of his most pleasant ways, and we are proud in leaving this convention to say that he has kept up to that high standard set by his predecessors. I am sure we all love him, also his estimable wife and daughter.

To Mr. Skidmore—I think I have said enough, but all I can say is I hope he will continue to come to these conventions, where he will be just as welcome as the flowers in May.

I also have the duty of thanking the membership for the recognition that Miss Unkenholz received on the boat. I think she asked me to state in her modest way that she fully appreciated the cash which she turned into silver which she can always prize as a gift from the association.

To the Gibson Priddle Company for the books they have sent to the convention, and last, but not least, our thanks are due to our able Vice-President, who has rendered valuable assistance to the President. May he continue as our President with good health. May the membership, especially in the South, be increased 30 or 40 per cent. in the next year. We have given you three members on the executive committee. Now make good.

The auditing committee reported that they had audited the books of the Secretary-Treasurer and found a balance of $111.44 in the treasury as follows:

Collected at convention	$346.00
	234.65
Balance	111.44
General fund	73.41
Balance on hand	$184.85

On motion the report was received and spread upon the minutes.

President Hanson: I personally want to thank all the members for their indulgence. I do not know that I have attended a meeting where the members have stayed in the convention hall and confined themselves to work as they have here, and I certainly appreciate it.

Thereupon the convention adjourned to meet at the call of the executive committee.

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E. Hacking, G. F.—G. T. P. R. R., Transcoma, Man., Canada.
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BOOK REVIEW

The Job, The Man, The Boss

"And he took his staff in his hand, and chose him five smooth stones out of the brook, and put them in a shepherd's bag which he had, even in a scrip; and his sling was in his hand: and he drew near to the Philistine." Is there anyone who reads these lines who would deny that David made careful selection of the kind of stones which, by long practice, he could throw with the greatest accuracy. As a mind-process his reasoning amounted to a species of "foretelling." He judged how these stones would act, and his judgment was based on previous knowledge.

In the book before us, *"The Job, The Man, The Boss,"* written by Dr. K. M. H. Blackford and Arthur Newcomb, and published by Doubleday, Page & Co., New York, N. Y., for $1.60, a very similar process of reasoning is explained. The engaging or hiring of men is the subject. Each man in the world bears about with him, in his speech, behavior and actions, the indelible record of his tastes, faculties and aptitudes. It is the work of the employment department, wherever established, in factory, mill, bank, or railroad repair shop, to view with the carefully trained eye of science each applicant for work, to which is added kindly worded questions, so that the observer, with what amounts to a fairly trustworthy knowledge of the man's past, revealed by build and movement, to predict his probable action and to "fit" him in his place; for like the story of creation, as Hugh Miller tells us, the Mosaic narrative is simply "prophesy" described backwards.

With this kind of knowledge, and learning the requirements of each job, the employment department picks out the best man available and places him where he ought to be, and where he will find his work congenial, and the result is that he will do his best work and please his employer and himself.

The book might well be in the hands of any intelligent foreman or gang-boss who has to handle applicants for work where the "hire and fire" system still prevails. A railway roundhouse, a small machine shop, or even a squad on the track would feel the benefit of the system here outlined.

It is pleasant reading, easily understood, and the matter lingers in the mind. The chapters on "Analyzing the Man," beginning with "heredity and environment," are fascinating and as good stuff as the best novel. The "nine physical variables" are defined and explained, how they came into being, what they mean, and what they still stand for, and why they are evidence of aptitude and character. This comes out in such a way that the reader feels it is all so natural that he wonders why he did not think of it himself. Yet this knowledge may easily prevent a boss from trying to put a square peg into a round hole.

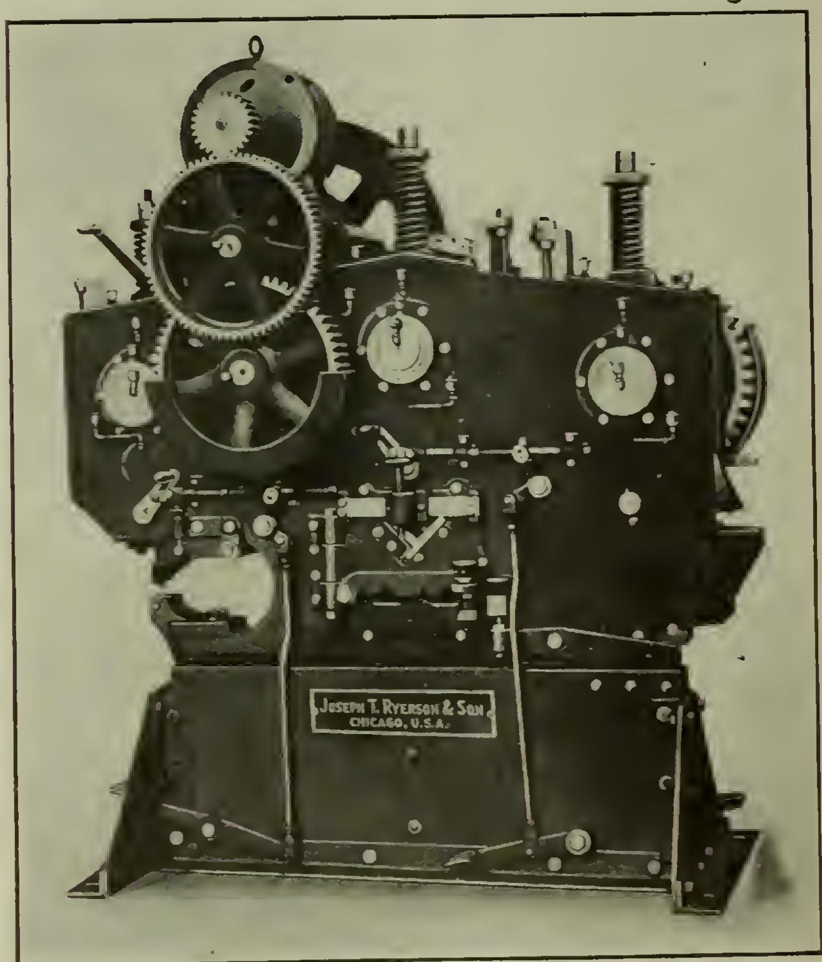
All men bear about, in face and limb and speech, certain evidences of character. They cannot conceal them, and the majority do not know they have them, but they betray likes, aptitudes and abilities in most unmistakable ways; the task is but to know how and where to look. The story is told that the mother of Achilles, fearing he would be drawn into the war with Troy, disguised him in woman's garb among the daughters of Lycomodes. Ulysses, the traveler in many lands, brought fine draperies and jewels as presents to the maidens, and each sought out that which pleased her most. When the rich fabrics and costly wares were displayed, a sword, hidden by Ulysses in the folds, fell out upon the floor, and the youth seized it as his prize. Gone was the fond deception and his mother's hope. Achilles stood revealed—later to wear Vulcan's invulnerable armor in the war. Nature will have her way, and her work stands revealed as Achilles before the observing Ulysses. This book can help us to read aright the "hall-mark" on each human frame and detect the stamp denoting quality on the outward covering of our real selves.

There are fifteen chapters contained in 266 pages, and there are twenty-three beautifully executed half-tones. It is full of useful "points" and things that help. Employer and employe may read with profit, and each judge himself intelligently, as well as apply his knowledge to help him understand his fellow man. The book is written in a kindly, helpful spirit that is brightly optimistic and looks for the dawn of a better day for all.

When we hire a man we do not, in this day of mechanical appliances, get a renewable reservoir of mere physical energy. We buy the product of his brains. That stands clearly out on railways and in other industrial enterprises, and this work points out the why. There is no idealism here nor idle dreaming, it is a clean-cut scientific fact. When you employ a man, if you want to know what you pay for, and how to look for what you want—read and learn, for the logic of the case is sound.

RYERSON QUINTUPLE PUNCH

There has just been placed on the market a new machine, known as the Ryerson Quintuple Combination Punching and Shearing Machine. This new tool combines five machines in one, and should be of special interest to railway shops and others. It is evident there has



Ryerson Quintuple Punch.

been a demand for a universal combination machine among structural and car shops that will do punching, shearing and notching work without the necessity of interchanging attachments or of having to maintain a number of single machines for each operation. This machine, which we here illustrate, has been designed to meet these conditions. It embodies several metal-working tion. This type of punch and shear is made in four dif-

machines in one, handling the punching, shearing, coping and notching work on plates, bars, angles, tees, beams and channels without interchanging any attachments for the various operations. Such parts as the punch, bar-cutter and splitting shear can be operated independently by automatic clutches, either by hand or foot.

The frame of the machine consists of a solid steel offset shear body, which permits the cutting of plates of any width or length. A hold-down, which can be adjusted vertically and horizontally, is provided with the splitting shear. By means of an improved arrangement of the bar-cutting device, angles, tees, round and square bars can be cut without change of shear blades. The upper blade, for shearing angles and tee bars, is of right-angle shape, which produces a cut without bending small or light sections. The shear blades are fastened to the slide in a simple manner and are made in four pieces. Stationary blades are mounted in a hinged steel frame. This enables easy removal and grinding of any part of the shearing blades. Adjustable hold-downs permit the cutting of various materials to a right angle, and a special attachment will allow the cutting of angles in miter up to 45 degs.

The punches are equipped with standard architectural jaw, permitting the punching of I-beams, channels and sections alike, in flange and web. A centering device is furnished with each machine.

The sliding head of the splitting shear is provided with an extension to receive the die block for coping and notching work. This die block is of rectangular shape, permitting the standard coping of light I-beams and channels, and the notching of angles, tees, zee-bars and other material. This combination machine is equipped with steel gears, cut teeth, and can be used for belt or motor drive. If direct electric drive is required, the machine is furnished with motor bracket, gear and rawhide pinion; the motor is placed on top of the machine. When the machine is arranged for belt drive, tight and loose pulley and belt shifter are supplied.

The sliding heads are made of crucible steel. Plungers are counterbalanced by heavy coil springs. Shafts and eccentrics are forged in one piece, machined and ground to size. Long bearings are provided for each shaft, bronze bushed.

The quintuple combined punching and shearing machine is made by Joseph T. Ryerson & Son, of Chicago, and is adapted for such shops as have not sufficient work to warrant the expense of separate tools for each opera-ferent sizes; each size can be furnished in eight different combinations.

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ANNOUNCEMENT

Mr. J. W. Barbour has joined the staff of the Railway Periodicals Company, Inc., as Western manager, with headquarters in the Old Colony Building, at Chicago. Since 1909 Mr. Barbour has been associated with the sales department of the Armstrong Brothers Tool Company, representing them in various parts of the country. During the past four years he has been their Eastern representative. He has thus come in close contact with railroad officials and railroad supply manufacturers and has a wide acquaintance among them.

From 1903 to 1907 he was with the Illinois Steel Company, being employed in the mechanical and production departments. He later became connected with the Elgin, Joliet & Eastern Railroad. He was in their employ for two years before joining the Armstrong Brothers Tool Company.

A GOOD SUGGESTION

At a recent dinner in Chicago, given in honor of the president of the Atchison, Topeka & Santa Fe, Chairman Trumbull, of the Chespeake & Ohio, put forth some excellent ideas, and among them a suggestion that all the regulations of the railroads by public authority should be applied, so to speak, regionally, in order that justice may be fairly and properly dispensed. This is a very pertinent suggestion, and one which if put in vogue would undoubtedly result in common good both to the people as well as the railroads. His idea is based upon the fact that to-day, as both rates and wages are adjusted in this manner, a more general application of the plan would produce a more comprehensive benefit. He expressed himself as follows:

"Please understand that I make no protest against regulation of railroads by public authority. Wise regulation is in the public interest; but regulation to be successful must be responsible, it must be consistent, it must provide some sort of assurance to future investors as to treatment which they will receive. If the treatment is niggardly even in a few states, railroad investment will be restricted. If the treatment is liberal, railroad investment and enterprise will be stimulated. The fundamental weakness of the present situation is that, by reason of the inconsistency, the complexity and often the contradictions involved in the present system of regulation, the railroad officer cannot make any promises as to the treatment which investors in his property will receive. That is a difficult position in which to put any conscientious man seeking additional capital. Again, no matter how well or satisfactorily the Interstate Commerce Commission may do its work, the entire fabric can be disarranged through conteracting influences of state commissions and legislative bodies.

"More and more people are coming to believe that what the United States has done for its banking system should also be done for the common carriers. One way of finding a regulatory system better than the present would be to group the states into regional sections, much as the federal reserve system is arranged, as suggested some time ago by Mr. Ripley.

"Have you observed the evolution which is going on in connection with the railroads? More and more questions are being considered regionally. For example, wages and rates. Would any one expect the employes of the railroads to consent to a different rate of pay in each state? In the rate hearings, presentations to the Interstate Commerce Commission are made by the railroads in large regional groups, and the states themselves are co-operating regionally in their opposition. The fascinating task of this generation, therefore, converges upon methods for promoting national unity. This country is taking back from Europe by the millions its own securities; I hope it may own them all. If the railroad and other statesmen can, by friendly, intelligent co-operation, make railroad stocks so desirable that any man or woman will be glad to put his or her savings directly into them, railroad debts can be carried much easier, the railroad

problem will be solved, and the incomes of those who save will be increased, in comparison with rates allowed by banks on savings of depositors.

"If the government can by legislation make banking safe, and the transportation of property and people safe, can it not also promote safety of railroad stocks. If I seem to criticise our present system of regulation, it is not to criticise the principle or to seek relaxation in the stringency, but to ask that the public give its thought to bringing into existence a scheme of regulation under which railroad officers and investors in railroad property may know, one way or another, precisely what they may expect from public authority."

When the question of resuming "specie payment" agitated Congress forty years ago, and all sorts of schemes and ideas were proposed by our argumentative lawmakers to bring this about to the best advantage and the discussion waxed indefinitely long without prospect of a satisfactory conclusion, John Sherman, then Senator, casually remarked that the way to "resume" was to resume. Following this the government did "resume," and so the momentous question was settled.

This question of regional regulation of the railroads suggested by Mr. Trumbull might be settled in the same way, if it were once spread before the country. Let our legislators busy themselves forthwith then, having this in mind.

OBJECT LESSONS

Railroads are not always at fault. Some people, however, think so; but records establish the fact that 72 per cent. of all railroad accidents, outside of collisions and other casualties which might be charged to neglect on the part of railroad managements in the handling of trains, are due to carelessness on the part of individuals, who thereby contribute to their own misfortunes.

During the year 1914 the style of women's costumes was somewhat of a factor—high heels and narrow skirts—and, besides this, arms full of bundles or babies added to gross inattention, were to blame for 69 deaths and 2,000 injuries occurring when individuals were alighting from or boarding trains, while accidents at crossings accounted for 1,147 deaths and 2,935 injuries.

Trespassers on railroad property came to grief to the number of 5,471 killed and 6,334 injured. These are startling figures, if not interesting.

The Long Island Railroad management is contending strongly against the habit that drivers of vehicles, especially motorists, have throughout that system, of paying no attention to either signals, flagmen or closed crossing gates, driving by or through them at top speed. The experiences on Long Island are only examples which may be found daily the country over. If the public, which is usually so exacting, would co-operate with the railroad managements many of these casualties would be averted.

It might be drastic to hold careless people wholly responsible, as they are in the streets of Paris, when run down, but it would seem that a spirit of carefulness would thereby be promptly inculcated.

Fortunately, the 1915 model for women's gowns warrants wider skirts, and therefore it is an insurance against some of these accidents which have gone to swell the tolls for carelessness; but as for high heels, it is a safe prediction to announce that they will never be abandoned. Since the days of sandals in Bible times there is no record that the fetching high heels, on occasions at least, have not been popular. So far as babies are concerned, where can a better place to put them than the mother's arms be found, provided the custom be attended by the exercise of strict attention and great care when the mothers set out on journeys by rail?

THE AUTOMATIC STOP SIGNAL

The very excellence of a thing may sometimes compass its undoing, or at least retard its progress. The objection, sometimes urged, against the automatic stop signal is that by its very sureness it produces a species of carelessness. This is said to come about by reason of the great dependence that will be placed upon it by those who have the running of trains. If an engineman knows, the critics say, that he cannot pass a block signal, and that if he attempts it he will not succeed, they argue that he will rely upon it, and that by reason of this very reliance he will not look out for it, believing it will act, and so he will become careless.

At first this argument looks plausible, but the results obtained where the stop signal is used do not justify this conclusion. Several subways in our large cities use these automatic stops, but it is seldom that they are overrun. It is not good railroading for a man to be stopped by a signal that he has carelessly attempted to pass, and there is a very large majority of enginemen and motormen who would hold themselves cheap if such automatic intervention took place. A good man invariably takes pride in his work and that fact should not be overlooked.

If, however, the justifiable pride in good work on the part of an engineman be left out of consideration, it is yet possible to devise a method whereby the outside automatic stop may be made to record the fact that it has been called into operation. Even if a man be adjudged careless, he may be made to write down the tell-tale information concerning his action on the device or on the car itself. It is quite possible for a man to close a door quietly and surely, and the fact that he is made to do it, each time he passes through, does not in itself produce a high degree of carefulness, though it does stimulate his memory and even his observation for the door itself. It, however, takes time and attention. A door check will do the same work and thus make the passage through the door less of a mental effort for the man, and the result will be the same for those who depend on the door being closed quietly.

An engineman's attention is always occupied. It may be concerned with the engine, the steam, the speed, the work of the fireman, the injector, the lubricator, the signals and the road ahead. These things make all sorts of demands upon him, at all sorts of times. The signals

make recurring demands in, roughly speaking, equal distances or times, and if two attention calls come at the same time, it is likely that a very slight mental delay will occur and his thought effort be just slightly increased. This may be all true enough and no great harm be done, for we know that thousands of enginemen run trains and look after all that comes along without a slip.

Nature, however, is always trying to make a constantly repeated act become a semi-reflex one, or as we usually say, it tends to become automatic. Cases can be brought forward where men running fast passenger trains have, at a particular point on their run, not seen the signal in the "stop" position for years. When it is at last against them, through some accident or emergency, there is a tendency that the signal will, nevertheless, appear to them to be "clear" when actually it is not. The automatic stop signal would prevent the results of the man seeing what he expected to see. This danger actually exists, as many instances prove. For years the man saw "clear," and his mind received the recurring impression, and with the mind's proneness to accept the "clear" as normal then, in the emergency, the semi-reflex got in its work and he missed. There is always this danger to the man, and he must be on the watch against it. It does not often occur, but it sometimes has occurred and the automatic stop eliminates that chance of error, and it may be made to record the delinquency. One straight case of immunity from some appalling accident is worth more in reputation, in money and in lives than any initial cost.

The study of the mental make-up of the human being has been carried on more or less in a way which has furnished information for the professor of psychology in a university or for the speaker on the lecture platform. As far as applying it to the practical work of railroading, this view of a man's mentality and the resultant action it may produce has not been taken seriously. The advance of science has revealed the existence of this hardly-suspected fact, and the need for its complete recognition is growing more and more insistent. Many railroad men know of cases where a human failure has resulted most disastrously, and where the delinquent has himself acknowledged that though his body was in the cab his mind was far away. The automatic stop is intended to save all concerned under these circumstances.

The automatic stop is no reflection on the ability of the large class of enginemen who habitually do not fail either mentally or physically, and there is no doubt that the great majority of our trains are properly and safely run; yet the additional safeguard of which we speak has a distinct and vital value.

It is at least quite arguable that the automatic stop will not make men careless, because there is always the pride in good work to operate against the chance of being caught, and the stop signal itself may be made to record its action. On general principles, one may say that, given a good man, operating a good machine, the probabilities are that the man will fail first. The machine, even in failure, can be made to take the safe side, but a man cannot. The animated machine we call man has not been fully studied yet as to his mental make-up, or capacity, and the result of the forces operating upon him have not been examined and analyzed as completely as they yet will be.

EXAGGERATED CAPACITIES OF MACHINES

One of the processes quietly acting in the railroad world in these years of financial depression is the gradual discovery that some of the machines in the repair shops cannot deliver their rated capacity of work. Under norchinery is being bought to meet increasing demands in the mal conditions it has been considered good practice to have sufficient shop machinery to carry on all the normal work, with a good factor of elasticity, should emergency require a sudden increase of output without giving time for increase in facilities. This has, no doubt, been an economical method when it is considered that the wear on a machine that is run only to within say seventy-five per cent of its rated capacity is, with proper care, inappreciable.

But now, with enforced curtailing of expense, little maway of repairs to old motive power and rolling stock that is getting older and not being replaced with much new equipment. And shop forces are being reduced until it is imperative that from each machine that labor is operating, the maximum output within its rated capacity must be realized in order to spread what money there is for labor as far as consistently possible. When this full realization of rated capacity is demanded of machines, a larger number of machine failures have come to our attention than seem to indicate that all machine capacity rating is on a proper basis.

A case in point is in the failure of the cutter rail of a planer, which was working so much within the rated capacity of the machine that there was no ground for argument when the manufacturer was called on to replace the broken parts. In fact the man in charge of the shop offered the manufacturer's representative an occular demonstration of the inability of the same part of a similar machine to perform work quite within its supposed power, if the manufacturer would replace the part when it failed.

The practise of over rating the capacity of machines does not bring permanent prosperity to a manufacturer, though it may lend itself to some forms of competition. The profit on a machine, in these days of scarce orders and keen competition, seldom includes enough to make possible the replacing of an important part of a machine without making the whole transaction represent a tangible financial loss. This would be especially true in the case of a shop where many of any one kind of tools were failing in succession as the department was being pushed up to its rated output.

Aside from the discouragement to the shopmen, there is the unpleasant delay in waiting for parts to be replaced, and the unprofitable diverting of the work of this machine into channels where it cannot be done as efficiently. No manufacturer can expect to have his line of machines praised by one railway shop superintendent to another, whose machines have failed in legitimate service.

The money that would be saved by preventing these unnecessary replacements might far better be utilized by the manufacturer in increasing the actual capacity of the machine to a point where it would have a safety factor above its rated capacity. Or, again, it might be used to determine by experiment and test under service conditions, the capacity at which a machine may be safely and honestly rated for day in and day out service.

Mountain, or 4-8-2, for Seaboard Air Line

Ten Mountain or 4-8-2 type locomotives have recently been delivered to the Seaboard Air Line by the American Locomotive Company. These Mountain type locomotives were placed in service between Richmond, Va., and Columbia, S. C., in place of some Pacific type superheater locomotives having 23-in x 28-in. cylinders, 72 in. drivers, 195 lbs. boiler pressure, total weight of engine 223,000 lbs., and 34,200 lbs. tractive power.

The new Mountain type engines have a total weight, i.e. engine and tender, of 499,000 lbs, and a tractive power of 47,800 lbs. The Pacific type engines which were superseded had a total weight, engine and tender, of 397,300 lbs. Thus an increase in total weight of 25.8 per cent.; an increase in tractive power of nearly 40 per cent., combined with a more efficient boiler, was obtained. According to the American Locomotive Company's method of calculating boiler capacity, the Pacific type formerly used had an 86 per cent. boiler, while the Mountain type which we illustrate has a 98 per cent. boiler.

All-steel through passenger trains, consisting of 10 to 13 cars, are being handled by these Mountain type locomotives, the regular trains being 10 cars. The locomotives are assigned to runs from Richmond to Raleigh, 160 miles, on which there are several grades of 1.2 per cent. 2½ miles long; and from Raleigh to Columbia, 207 miles, on which there are several grades of 1.25 per cent., 3½ miles long. The necessity for the introduction of the 4-8-2 type was on account of the inability of the Pacific type to maintain schedule up grade with 10 or more steel cars without at times exceeding the maximum speed limit of 50 m. p. h. The Pacific type locomotives with 11 cars would drop back to from 18 to 20 m. p. h. before reaching the top of the heaviest grades, while the Mountain type can maintain a speed of from 35 to 40 m. p h. with the same train. On some occasions they have handled 12 heavy steel cars, maintaining a speed of 35 m. p. h. up grades.

Fuel consumption of the Mountain and Pacific type locomotives handling the same train show: Mountain type, 12 lbs. per car mile, and Pacific type, 13.5 lbs. per car mile. This is a saving in favor of the Mountain type of 11 per cent.

In addition to their ability to maintain schedule speed up grade, the Mountain type locomotives have given a good performance when starting trains at stations where grades are heavy. At certain stations with the Pacific type it was necessary, with 10 cars or more, to take the slack, and at times it was necessary to back the train up to a point off the hard pull. With the Mountain type it is the exception to have to take the slack and it has never been necessary to back off the hard pull.

This design was developed by the mechanical department of the Seaboard Air Line in co-operation with the American Locomotive Company as a part of the programme of that road in the reduction of operating costs. Its success is of interest from the fact that it is another road which has adopted this type of locomotive for heavy, moderately fast passenger service.

Some details of design include a 34 unit superheater, a 44¾ in. combustion chamber, firebrick arch, long main driving box, Cole outside bearing trailing truck, Woodard engine truck, and radial buffer.

The cylinders are 27 x 28 ins. The driving wheels are 69 ins. outside diameter, and have factor of adhesion of 4.4. The main valves are of the piston type, with 7 ins. travel, steam lap 1¼ ins. The exhaust clearance is 3/16 in. and the setting is line and line forward, and ⅜ in. lead in full back gear. The tender is of the cylindrical type, commonly called the Vanderbilt tank, and can contain 9,000 U. S. gallons, and carries 17 tons of bituminous coal. The engines were built at the Richmond, Va., shops of the company. Some of the principal dimensions are as follows:

Wheel base driving, 18 ft; rigid, 18 ft.; total, 38 ft. 11 ins.; wheel base total, engine and tender, 76 ft. 8½ ins. Weight in working order, 316,000; on drivers, 210,500; on trailers, 52,500; on engine truck, 53,000; engine and tender, 499,000. Boiler, type, extension wagon-top, conical connection; O. D. first ring, 76½ ins.; working pressure, 190 lbs. Firebox, type, wide; length, 114⅛ ins.; width, 84¼ ins.; combustion chamber, with length 44¾ ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5½ ins.; sides, 5 ins.; back, 5 ins.; firebox depth (top of grate to center of lowest tube), 28¼ ins. Crown staying, radial. Tubes, material, seamless steel; number, 193; diameter, 2¼ ins. Flues, material, seamless steel; number, 34; diameter, 5½ ins. Thickness tubes, No. 11 B. W. G.; flues, No. 9 B. W. G. Tube length, 21 ft.; spacing, 13/16 in. Heating surface, tube and flues, 3,396 sq. ft.; firebox, 293 sq. ft.; arch boxes, 26 sq. ft.; total, 3,715 sq. ft. Superheater surface, 865 sq. ft. Grate area, 66.7 sq. ft. Wheels, driving material, main, cast steel; others, cast wheels; wheels, engine truck, diameter, 33 ins.; kind rolled steel; wheels trailing truck, diameter, 42 ins.; kind, cast steel spokes; wheels tender truck, diameter 33 ins.; kind, rolled steel. Axles, driv. journals main, 11½ ins. x 21 ins.; other, 10 ins. x 12 ins.; axles, engine truck journals, 7 ins. x 12 ins.; axles, trailing truck journals, 9 ins. x 14 ins. axles, tender truck journals, 6 ins. x 11 ins. Boxes, driving, main,

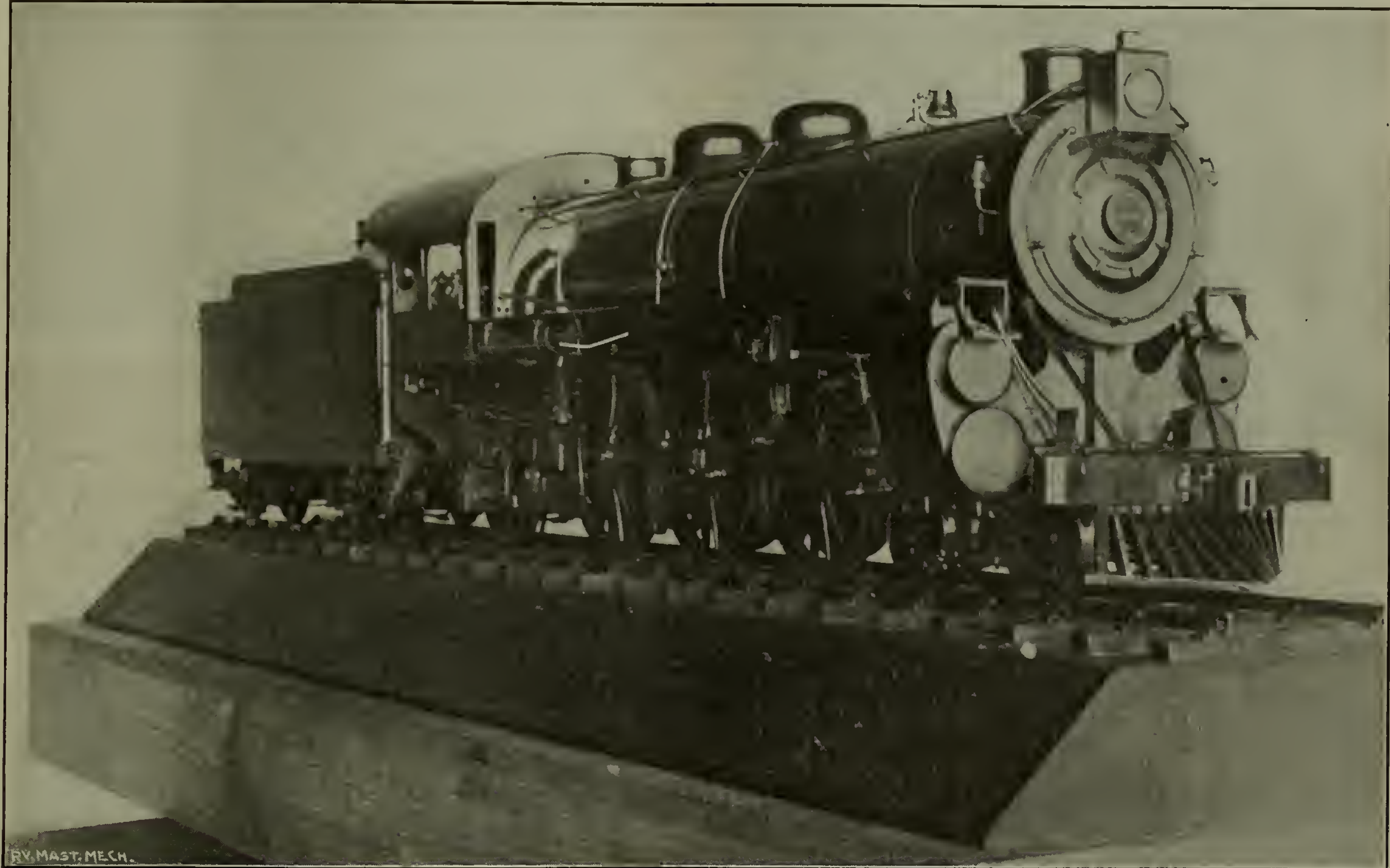
J. W. Small, S. M. P. **Mountain or 4-8-2 Type Engine for the Seaboard Air Line.** Builders, Am. Loco. Co.

cast steel; others, cast steel. Brake, driver, American WN 3 BC, West ST No. 6; truck, tender brake Westinghouse ET No. 6; air signal, Westinghouse Schedule L; brake pump, 2-9½ ins. West.; reservoir, 1-22½ ins. x 108 ins., 1-22½ ins. x 42 ins. Trailing truck, radial, Cole type. Exhaust pipe, single; nozzles, 6 ins, 6⅛ ins., 6¼ ins. Grate, style, rocking. Piston, rod diameter, 4¾ ins.; piston packing, U. S. Metl. King type. Smoke stack, diameter, 19 ins.; top above rail, 180½ ins. Tender frame, Commonwealth cast steel.

A BUILDER OF MODELS

What will doubtless be of interest to some of our readers, especially apprentices and other young men of a mechanical turn of mind, is this brief story of a builder of models, one who never worked a day on a railroad and who now calls himself only a layman. The illustration herewith explains itself and the maker of the original machine as well.

The most elaborate model built by him is the one referred to in this article. It is a miniature locomotive of the "Pacific type," constructed from working drawings and specifications for the American Locomotive Company. It is made accurately to a scale of one-half inch to the foot or one-twenty-fourth of the actual size—a faithful reproduction of its prototype and so true in every detail that one might imagine that the illustration presented here is a photograph of an original machine that is doing its work on the road. The fact is, this model if fired up will go like its prototype, but it might fail to make time with full sized passenger coaches attached. William H. Coombs, the builder, is a man of leisure, with a taste for machinery. Some of the models he has made, mostly for amusement, are now preserved by large manufacturing establishments, big railway systems or are treasures in the archives of museums. His case is mentioned with the notion that perhaps some reader may find that he, too, is gifted in a similar way and may gain both amusement and profit by indulging a taste which is especially prominent and ought to be cultivated. This model stands in a neat glass case in the entrance hall of the American Locomotive Company in New York, N. Y.



Coombs' Model of American Locomotive Company's 4-6-2 Engine.

SOME INTERESTING FACTS

Freight is hauled in India more cheaply than in any country in the world, except the United States. In India the cost of labor is extremely low. The wages paid railway employees in the United States are higher, on the other hand, than in any other country. In Western Australia receipts per ton are almost twice as much as in the United States. In the United States the average annual wages paid railway employes in the year 1912 were $730, and only in New Zealand, Australia and Canada do railway wages reach even half that amount. Japan pays its railway men $114 per annum on the average.

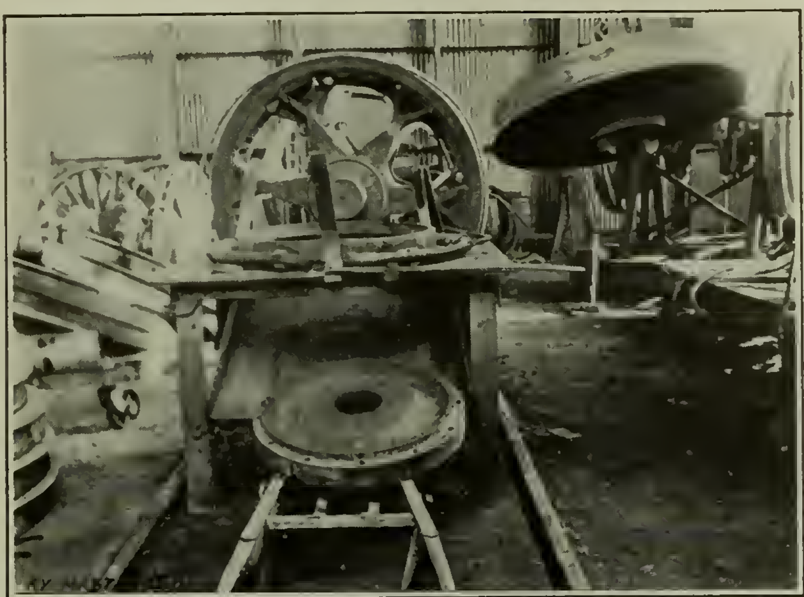
So far as capitalization per mile goes in the different countries, it is interesting to note that Great Britain heads the list at $277,147. Belgium comes next at $216,143; then Russia at $149,814; France at $148,146; Switzerland at $122,010; Austria at $121,327; Germany at $116,365, while the United States, with more than one-third of all the railway mileage in the world, brings up the rear at only $63,535, and the United States occupies first place over all countries as to progress in the way of service in the best interest of business and the public generally. These comparisons have been determined by the Bureau of Railway Economics after a careful and exhaustive investigation.

Words, if they are not watched, will do deadly work sometimes.—*Sesame and Lilies.*

North Billerica Locomotive Machine Shop

Boston and Maine Railroad

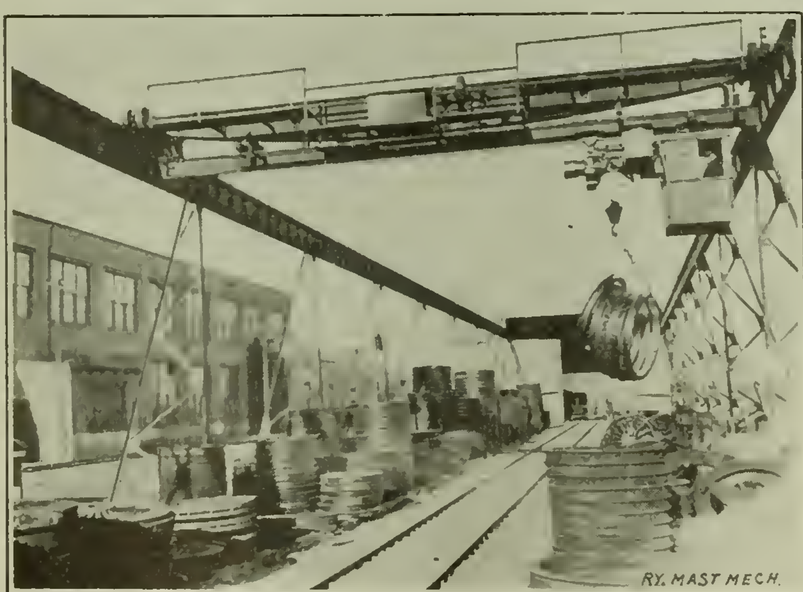
The locomotive machine shops of the Boston and Maine Railroad, at North Billerica, Massachusetts, can be considered as indicative of modern tendencies in construction of railroad shops in this country. For years before the shops were built a standing committee on shops and tools devoted much thought and energy to studying the problems of locomotive and car repairing, both as worked out in most advanced contemporary shops—railroad and industrial, and a forecast in the unrest and continual change



Removing Tires from Midvale Wheels.

to be observed in organizations and methods that have followed growing demands, rather than meeting or anticipating them.

The shops are located at North Billerica with the idea that if the present undeveloped plans for an electrified zone of twenty-five miles surrounding Boston, materialize, the inconvenience of hauling steam locomotives into this electrified zone to be shopped will be avoided. North Billerica is at the junction of the Lexington Branch with the main line of the Southern Division of the road and

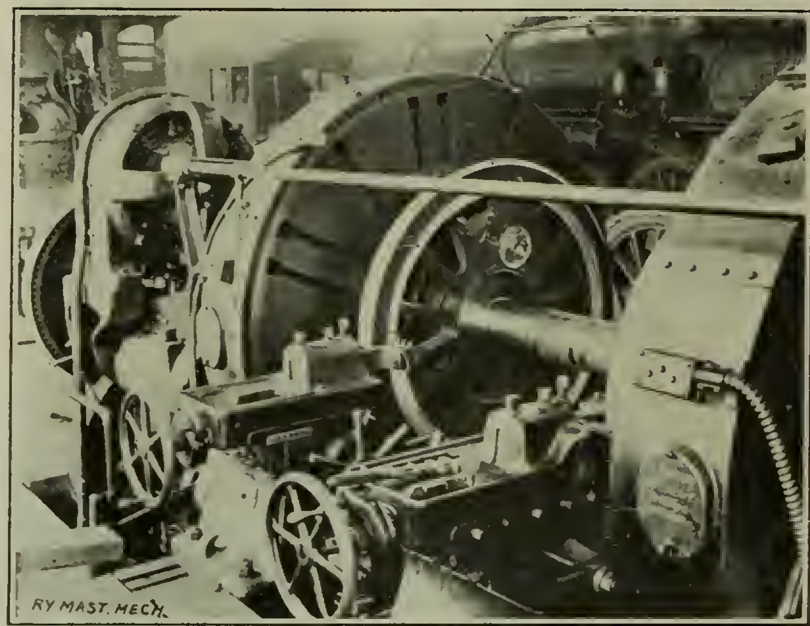


Tire, Wheel Center and Cylinder Storage.

enjoys many advantages of position from the standpoints of securing labor, material, coal and manufactured supplies.

Layout of Shop

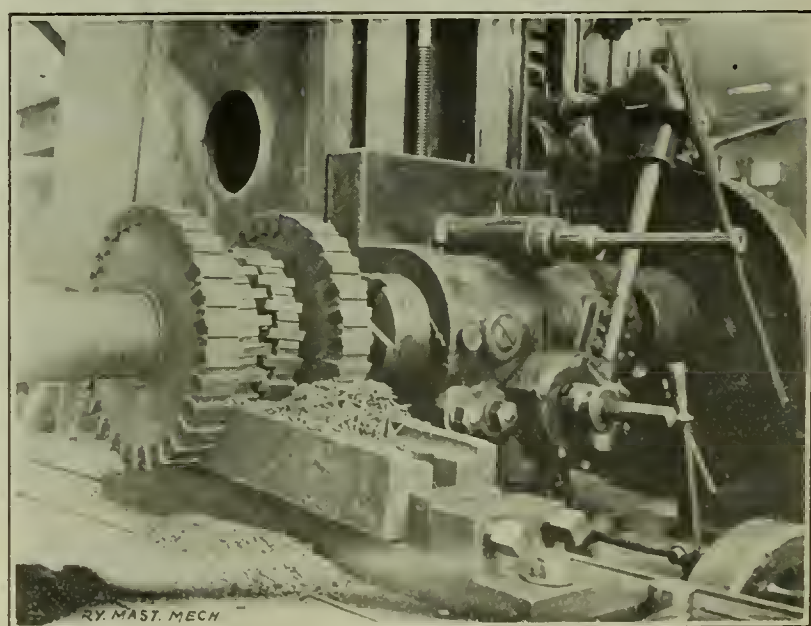
The locomotive machine shop, a building 160 ft. by 838 ft., with a gallery extending along one side, was completed in the middle of February, 1914, and shopped, in its first month, ten locomotives. The second month this was increased to twenty-three, the third to forty and in June fifty were handled. Forces were then reduced and the shop has been turning out about forty a month since,



Putnam 90-in. Combination Wheel Lathe Facing Wheel Center and Cutting Groove for Tire-Retaining Ring.

though the possibilities of the shop are far from being realized.

The shop is divided into two lengthwise bays by steel center columns supporting the roof, and looking down the shop from the north end, the left hand or east bay is devoted largely to stripping and erecting, with the extreme north end containing the wheel outfit, and the south one-third, the truck, tender and tank repair departments. This bay is served by four cranes, two of sixty-five tons



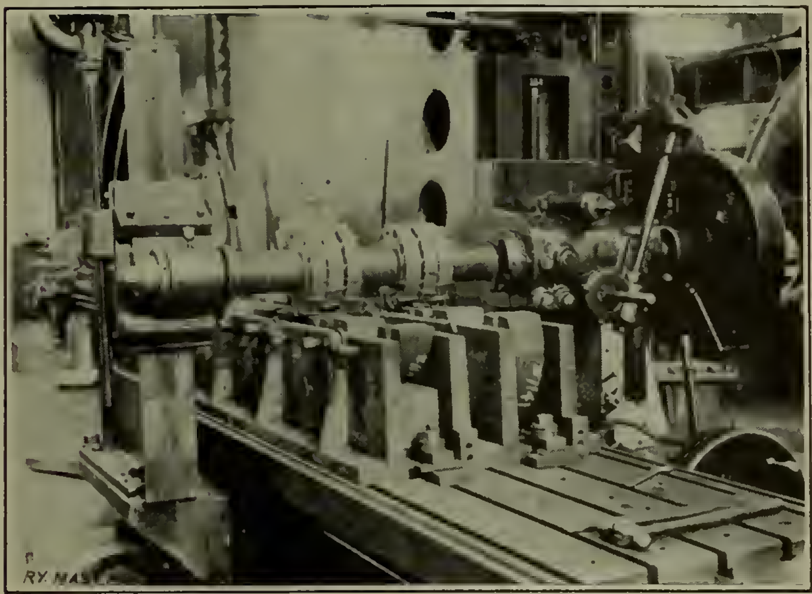
Ingersoll Miller, with Gang Cutter on Shoes and Wedges.

each, which combine to lift locomotives, a third of ten tons and a fourth of seven tons. A standard gauge track leads down the center, and there are parallel tracks on each side of the center. Two crossovers are provided, one connecting with the wheel house, near the north end; the other connecting with the lye-vat house, two-thirds of the way down the shop.

The right hand, or west bay of the shop, contains in its northern two-thirds all of the machine work with the ex-

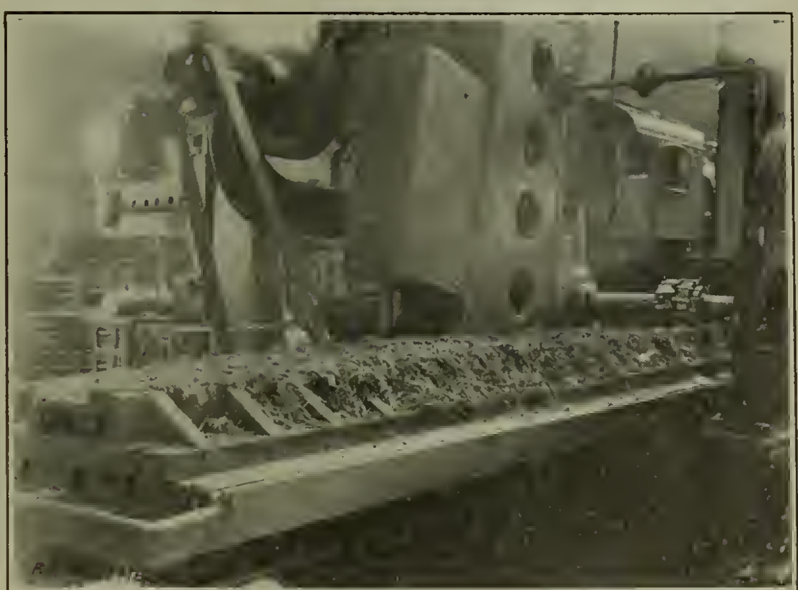
ception of the wheel work mentioned in connection with the left or east half of the shop. The southern third of the west bay contains the boiler and flue work. Down the center of this west bay runs a wide clear aisle or passageway, the whole length of the building, which is called the "midway."

Starting from the north, the machines are arranged in



Ingersoll Miller Cutting Tongue and Groove Fit on Eccentrics.

groups, according to the work that will come to them. First, on the right is the driving box group, while on the left is the wheel and axle group. Next on the right comes the link work group, and then the piston work. Opposite these two on the left is the planer section. On the right follow the general lathe work, the rod work and first floor tool room and office, opposite a group of machines working for the rod job and for the erecting shop. South of the tool room on the right is the spring-rigging and pipe department followed by machines for drilling and boring, and pipe machines. Opposite these on the left of the west



Ingersoll Miller Finishing Crosshead Shoes.

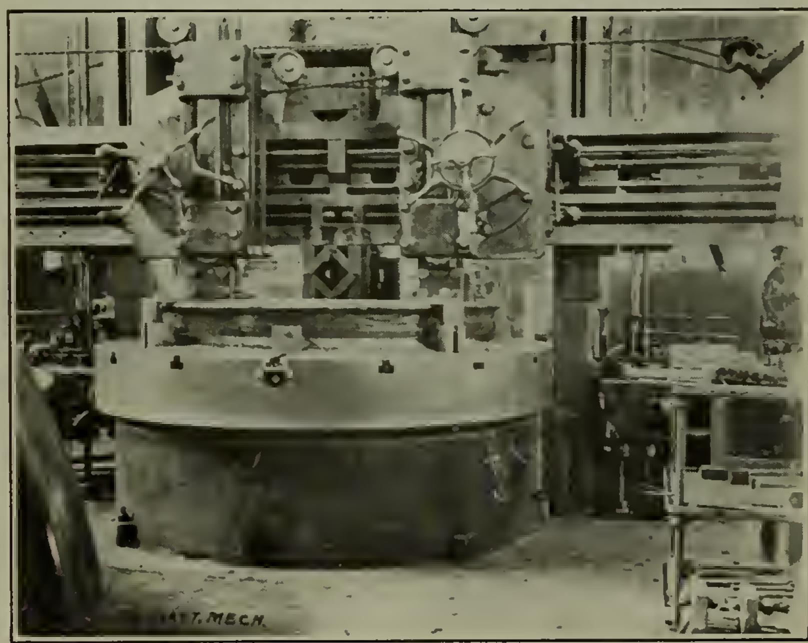
bay is the frame department which also contains the electric welding outfit.

Above the groups mentioned as being on the right-hand side of this bay, extends a gallery about one-half the width of the bay. On this gallery, starting at the north end, are located the wash and locker room, the painters' headquarters, the turret lathe department, the carpenter shop, the gallery tool room, the sheet iron and jacket work; and the brass, pumps, air brake operating parts repair work is next found.

Erecting Bay

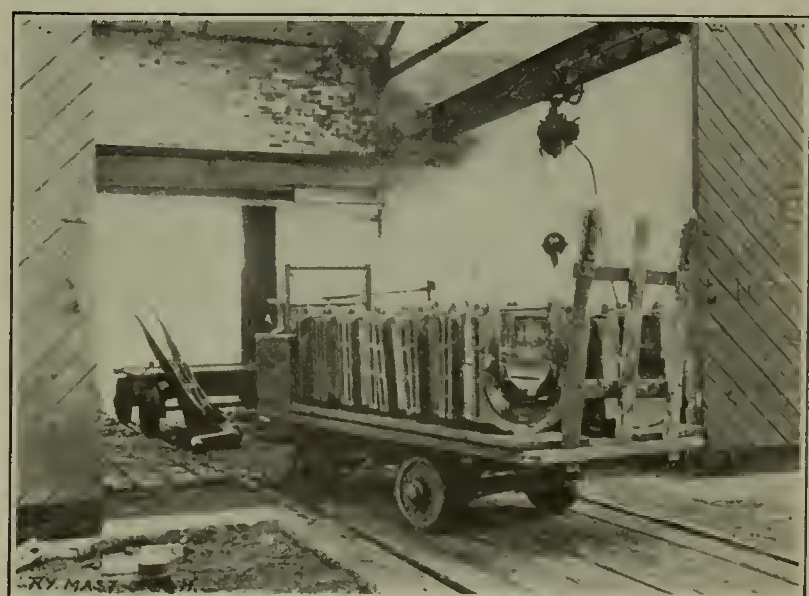
If we were now to follow an engine through the shop, taking it for granted that its repairs would involve all departments, we would find that a master mechanic's report as to its condition on the road, either precedes or accompanies it to the shop. The locomotive is taken to the coal and ash department, where the fire is dumped, the arch and grates are removed, all sand, coal and water are emptied and the engine is washed with hot water.

It then enters the east bay, at the north end, and is placed over the stripping pit. The east bay is under the charge of an erecting foreman who reports to the general foreman. An assistant foreman to him has charge of the stripping. The boiler gang remove the front end and the ash pan and prepare the locomotive for its first boiler test. Machinists are working underneath removing all



Betts Boring Mill Boring Tires—Roughing and Finishing Tools Feed Horizontally.

necessary parts to prepare for unwheeling. Pipers are taking down all pipes and reservoirs and as all parts are being removed from the locomotive, they are receiving the close inspection of the stripping assistant foreman, who turns in a written report, based on his personal inspection of the engine, as to the repairs necessary and the material needed. Working with him is the schedule man, who, taking into consideration the nature of repairs, the material ordered, the work in the shop, the number of men



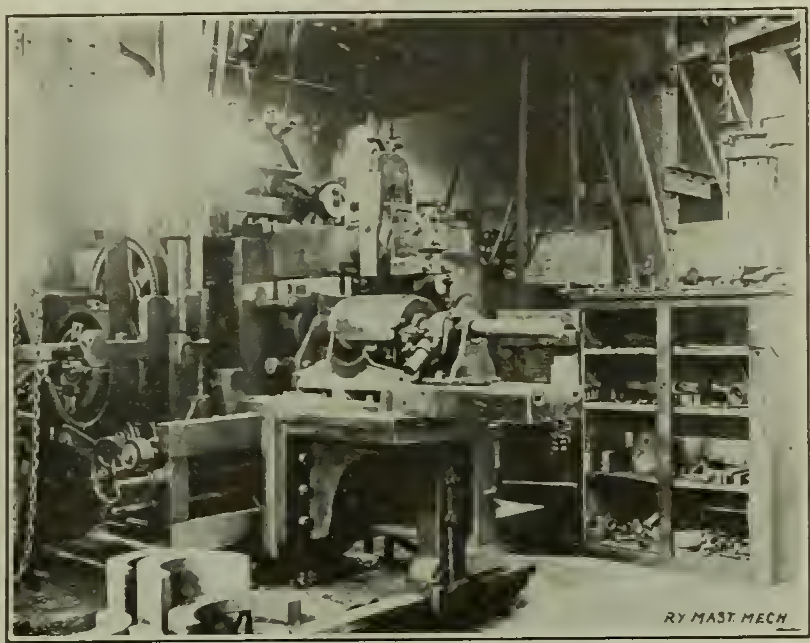
Two-Ton Electric Truck with 14 Driving Boxes from Lye Vat.

in the gangs and all other conditions, prepares the date schedule on which the work is supposed to progress day by day. Copies of this schedule go to the assistant foreman, who takes over the engine in the erecting shop, to the machine foreman, the general foreman, and to the office. This assistant foreman also orders all material not previously ordered from advance reports on the condition

of the engine. He also has charge of wheeling the engine when the repairs have progressed to that stage.

After the valves, shoulders, pistons, motion work, etc., have been removed the boiler is tested and then the engine is unwheeled and carried by the two sixty-five-ton cranes to its stall, where it rests on wooden blocks behind and jacks in the front. The engines are set on a slant so that flues may be removed without interfering with adjoining locomotives.

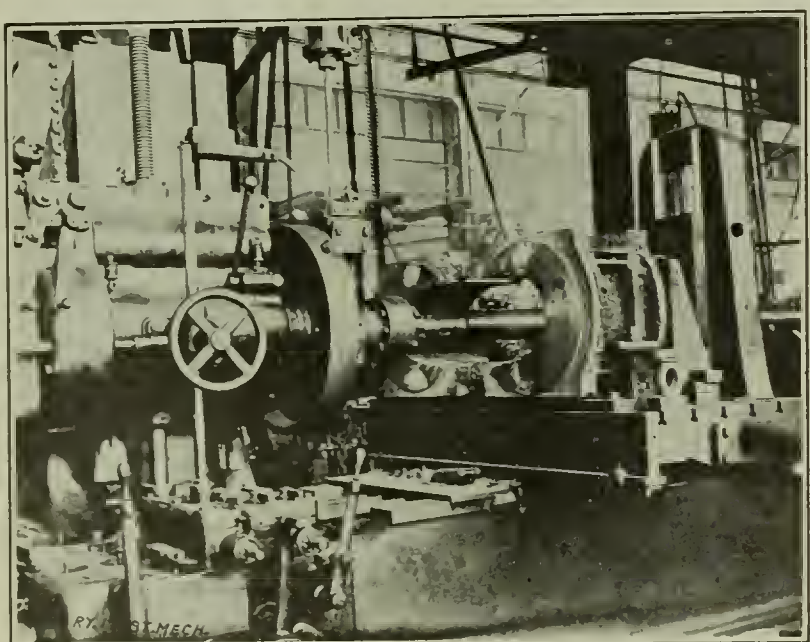
The piping, reservoirs, front end netting, and all brake



Norton Draw Cut Shaper on Driving Box Bearings.

and all other parts which are not to be repaired are carried on a truck up to the lye-vat house, where the reservoir is given a hydrostatic test while still on the cart. Then these parts are taken to storage stalls south of the shop, where each locomotive in the shop is allotted a space for these parts which do not need repairing or renewing.

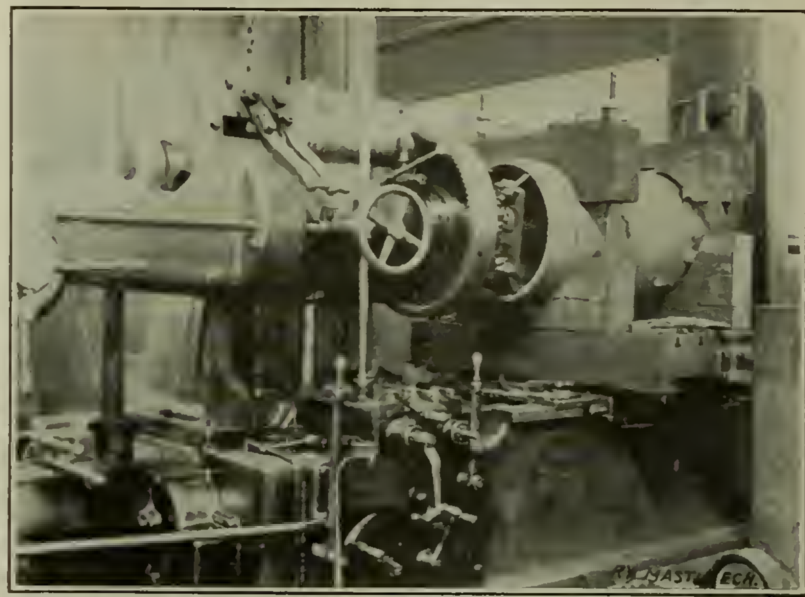
The stripping gang next clean the rods and sort out the brake rigging in need of repairs, by means of gauging the holes, etc., and these parts go to the smith shop if in need of repairs, and otherwise to the storage stall. The electric truck takes all parts, the larger parts individually, the smaller parts in baskets where advantageous, to the lye-



Lucas Horizontal Boring Machine on Right and Left Driving Boxes, In Pairs.

vat house. After these parts have been cleaned they are distributed by the electric truck to the various machine groups, where they will severally be repaired.

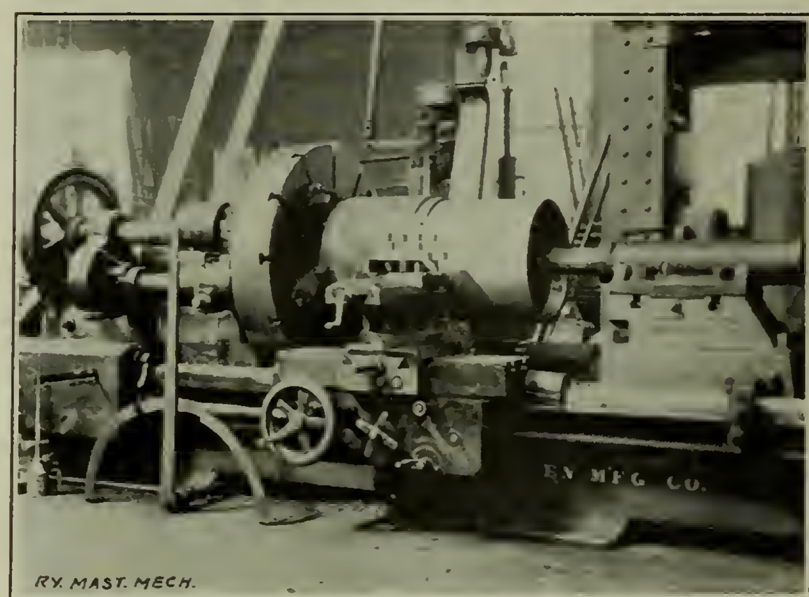
The locomotive on its blocking is now turned over to one of the assistant erecting shop foremen, who has a copy of the master mechanic's report, the inspecting assistant foreman's report and the schedule from the schedule man, showing what dates each part of the work is expected done. Each of these assistant foremen has an independent gang, consisting of specialized men for the varieties of work they do—such as a valve man, a front-end man, a



Lucas Boring Mill on Cylinder Bushing.

throttle man, a cab man, a guide work man, a frame man, a cylinder man, a running gear man, etc. In addition to such men, each gang has half a dozen good all around men capable of filling in or doubling up at any man's place in the gang. These gangs work at the repairing which can be done while the locomotive is blocked up in in its stall, and have charge of fitting the repaired parts to the locomotive. There is room for twenty-five engines on stalls, in addition to space for trucks, tanks and tenders.

While on its "stall" each engine has its branch steam pipes removed, and a flue cutting machine on the front



New Haven Lathe Turning Cylinder Bushing with Two Tools at Same Time.

end is operated by one man, while a boiler-maker in the fire box cuts off the beads. Flue cradles placed on extension legs which bring them up level with the man removing flues, are used to receive the flues as removed, and two men do the work usually allotted to three and sometimes to five men.

The flues are carried by crane to the flue department, at the south end of the west bay, and are cleaned and rumbled in a Ryerson overhead flue cleaner. The remainder of the flue equipment consists of a Fergusson furnace and a Hart flue welder.

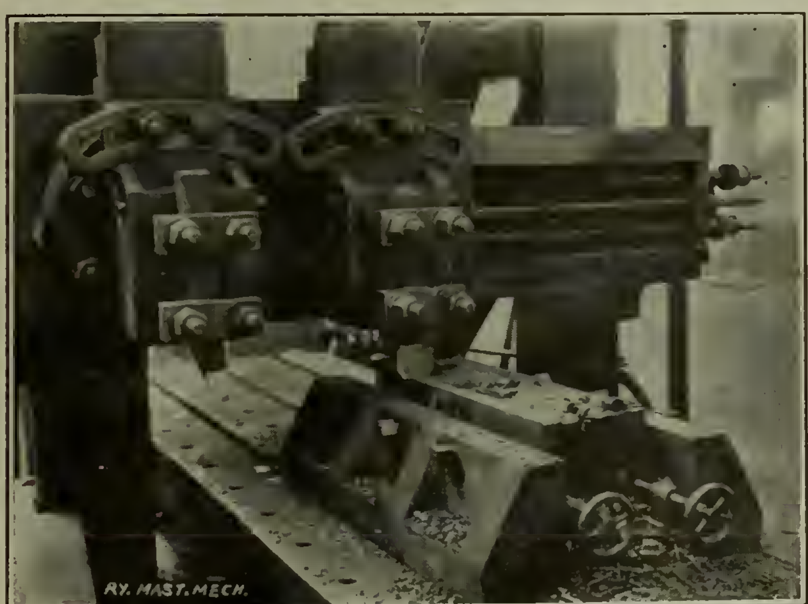
One equipment takes care of all the flue work for the shop and for the outlying engine-house points, and about

500 flues are welded a day to keep this work up to date. Special flue reclaiming machinery has been designed and built in the shop, which has enabled the record to be made that since this reclaiming machinery was installed the purchase of new flues has been very greatly reduced.

Ash pans are delivered to the boiler shop and are thoroughly overhauled. Back flue sheet or side sheet repairing is done by a boiler shop crew while the engine stands on its stall. If a new fire box is needed, the old box is cut off at the throat sheet, and delivered to the boiler shop floor, and the locomotive frame and the rest of the boiler is sent out of the shop to the yard until a few days before the new fire box is scheduled to be completed, ready for delivery to the locomotive.

Two 44-in. Drills Working on Crosshead Shoe (Left) and Drilling Steel Link Bushings (Right).

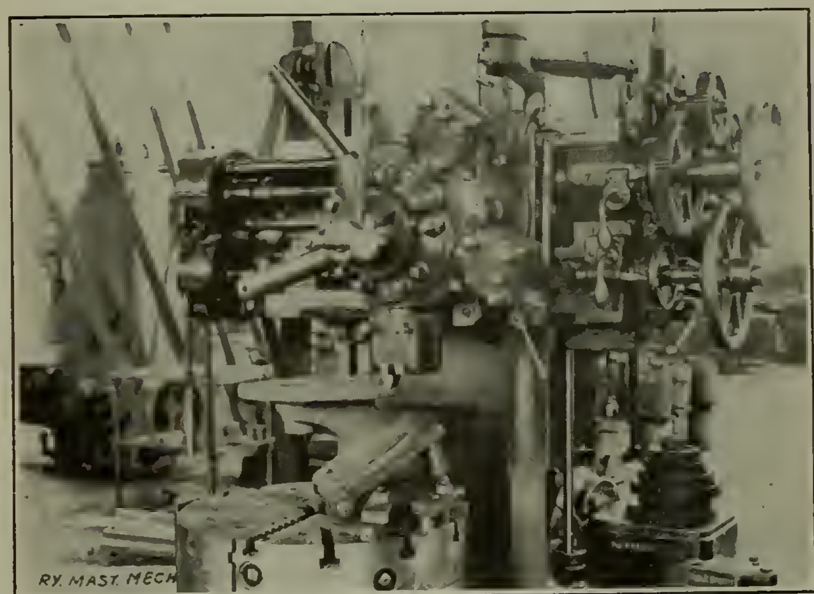
The boiler shop foreman divides his forces under two assistant foremen, in charge, respectively of each side of the erecting shop.



Woodward & Powell Planer on Shoes and Wedges. Finishing Tool Feeds 1 in. at Each Stroke.

Wheel Work

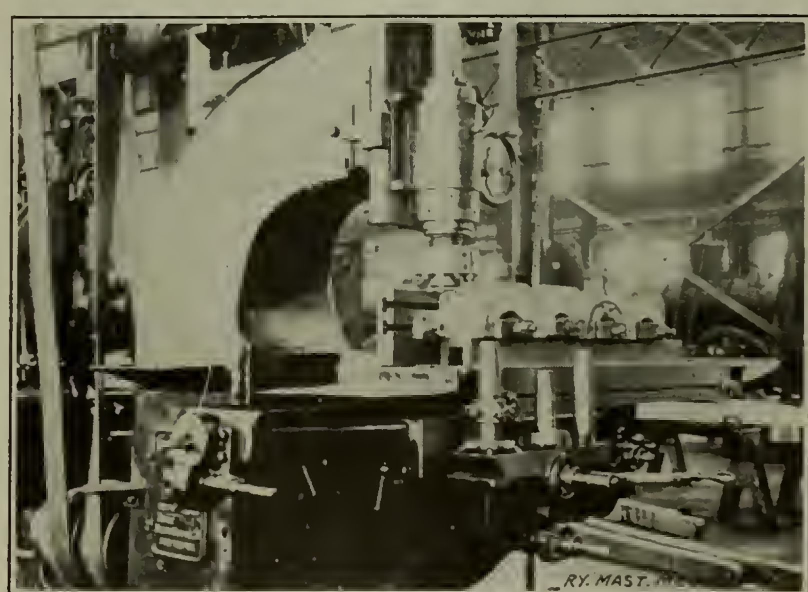
When the locomotive was unwheeled and set on its stall by the cranes, the wheels were rolled a little north to the machines grouped under a gang leader, to handle wheel work. The driving boxes are stripped and sent to the lye-vat house to be cleaned, and the wheels go to the wheel house to have the tires removed. In the wheel house is a Fergusson furnace which heats eight tires at a heat. There is also an outfifit in the wheel house, shown in an illustration, on which tires are removed from No. 6 Midvale wheels. This outfit was made in the shop. It consists of a table on which the wheel is laid, flange down, the tire supported by three lugs, two of which are stationary and the third hand-lever controlled. The heater burns crude oil which is pre-heated in a ring of ½-in. pipe and burned from a ring of 1½-in. As soon as the tire has expanded sufficiently to release the wheel center, the center drops on an inclined apron from which it slides to a waiting hand truck. A second hand-truck is then placed before the apron, and the lever-operated tire support is used to release the tire, which in turn falls on the apron and slides to its truck. An air hoist in the meanwhile has lifted the next wheel to the table and the operation repeats. As many as nine tires have been removed in an hour, with one man and two helpers.



Bullard Vertical Turret Lathe Machining Tank Valve.

A view is also shown of the tire, wheel center and cylinder storage. The good stock of tires, laid in before the prices advanced on account of the war, is a source of much satisfaction to the shop management. The Gantry crane shown travels down to the wheel house and then across the cross-over to the east bay of the locomotive shop, where it has access to the crane-rails. This proves a very economical method of shifting material.

Returning to the wheel machine group at the north end of the east bay, we find that this group is made up of one driving wheel lathe turning journals and another driving wheel lathe turning tires, a 600-ton wheel press, a 72-in., and an 84-in. boring mill, a 5ft. radial drill, a 25-in. drill for crank pins and hub shims, two 30-in. by 10-ft. milling machines, a 36-in. by 12-ft. planer, a 24-in. by 9-ft. lathe and a Bullard axle lathe, which is the only machine not

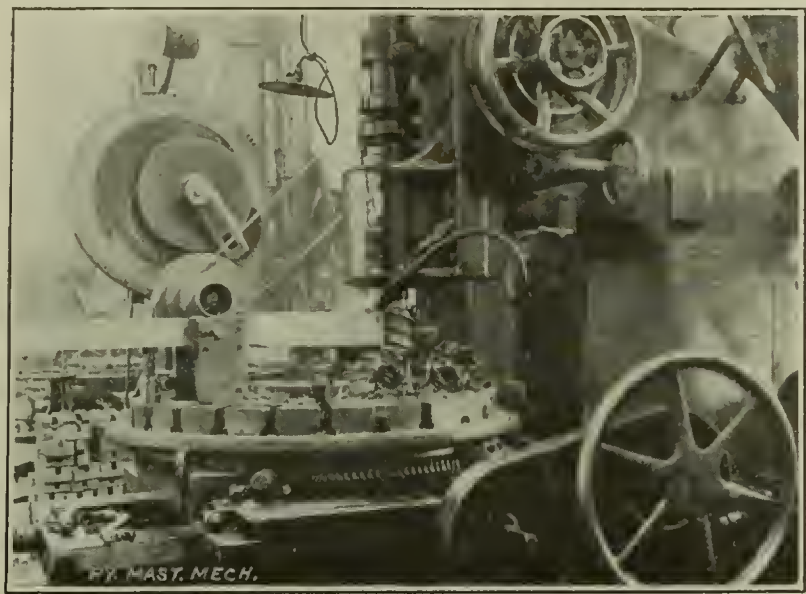


Becker-Brainard Vertical Miller on Back End of Main Rod Brasses. Cutter is Shown for Milling Inside of Flanges.

bought new in the whole shop and was brought down from the shop at Keene.

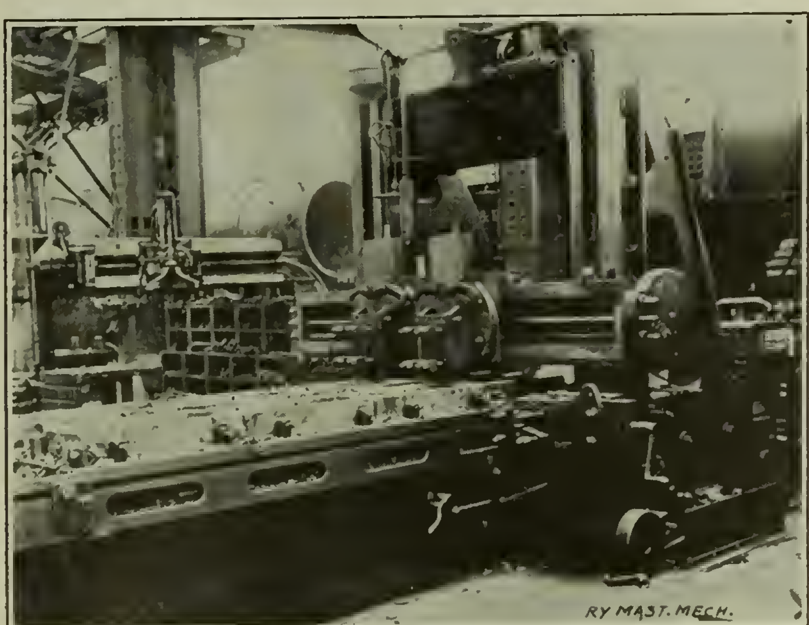
Of these the first five are driven by individual General Electric motors, and the remainder from a motor-driven shaft.

One illustration shows the 90-in. Putnam combination wheel lathe, equipped for turning tires on driving and



Niles-Bement-Pond Vertical Miller, with Individual Motor and Crane Attachment, on Front End of Main Rod.

trailer wheels. Journals can also be turned, either inside or outside for driving or trailer wheels, respectively. Quartering wheels and crank pin boring can also be done. The drivers shown in the lathe have had the tires turned, and are having the inside of the rim of the wheel centers faced and the groove is being cut in the inside face of the tire to receive the segmental tire-retaining ring that is being applied to all driving and trailer wheels as fast as



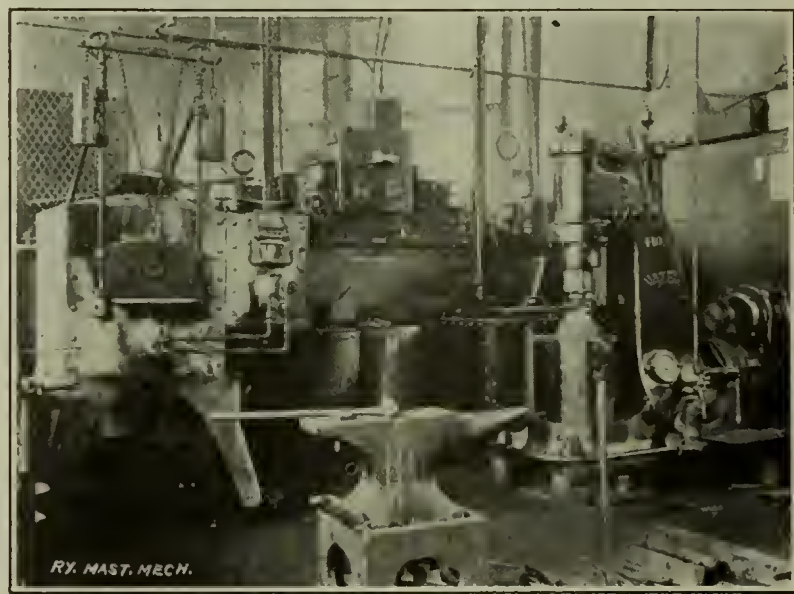
Niles-Bement-Pond Planer on Back End of Main Rod Straps. Two Tools on Eight Pieces.

the locomotives pass through the shop for general repairs. This lathe with its individual motor drive and its provision for cutting in four places at once saves much time in turning tires and hubs at one operation.

On the Ingersoll millers are shown three types of work on which they are making records for speed and economy. One is in milling shoes and wedges with gang cutters at one operation, and with only one setting required. On this work a machinist is milling five an hour, floor to floor, and the cutter faces both outer sides, sides and bottom of groove, and tops of flanges. This method saves two lockups and two milling, planing or shaping operations. The table feed is six inches per minute and the outside cutter speed about 50 feet per minute.

The tongue and groove fit of eccentrics is milled in a similar manner, except that two sets of four large halves and small halves, respectively, are set up at a time by means of two special double angle iron chucks. Eccentric straps where large and small halves meet are also milled to fit on these machines, using an end mill and special bar and clamps for set up.

Another operation for which a gang milling cutter has been found economical is in milling crosshead shoes. This operation is carried out complete—finishing the bottom and sides of the bearing surfaces and the tops of the guides at one cut. A row of five are set up at once and the table feed is seven inches per minute—giving with

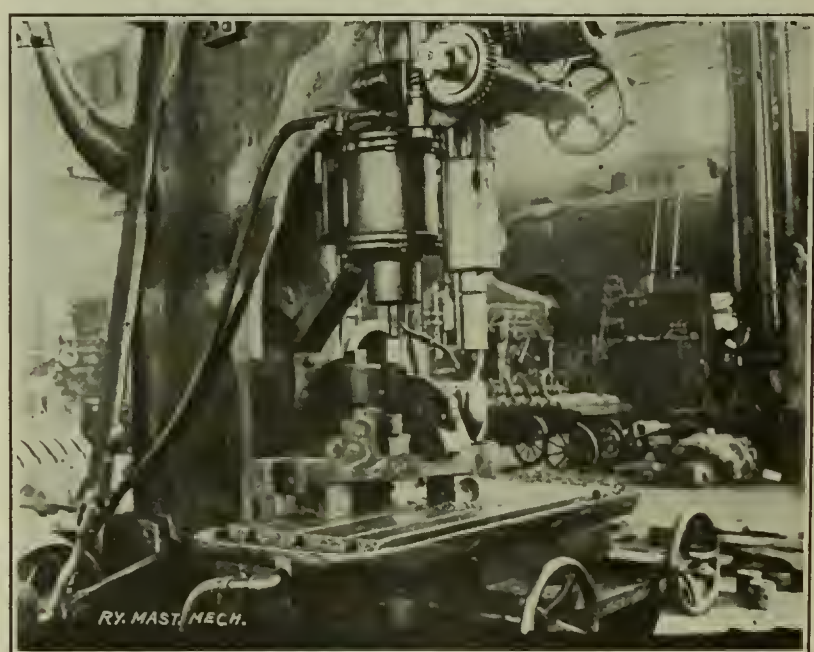


Heat Treating and Tool Dressing Outfit.

one man an output of four per hour, including set up. These millers are also used to cut key ways in driving axles.

An interesting feature of the milling work in this shop is that all the milling cutters are interchangeable from one horizontal machine to another and from the horizontal to the vertical machines, making for economy of tools. Some of the machines had to be built with special attention to this feature in order that the same tools might fit machines of more than one manufacturer, in the shop.

The method of boring tires is shown, in another illus-



Foot Burt Drill on Spring and Brake Rigging, Held by 8-in. Air Cylinder.

tration, on an 84-in. Betts boring mill. The two cutters, roughing and finishing, feed horizontally instead of vertically and enough time is saved to enable boring tires, floor to floor at the rate of one tire every thirty minutes.

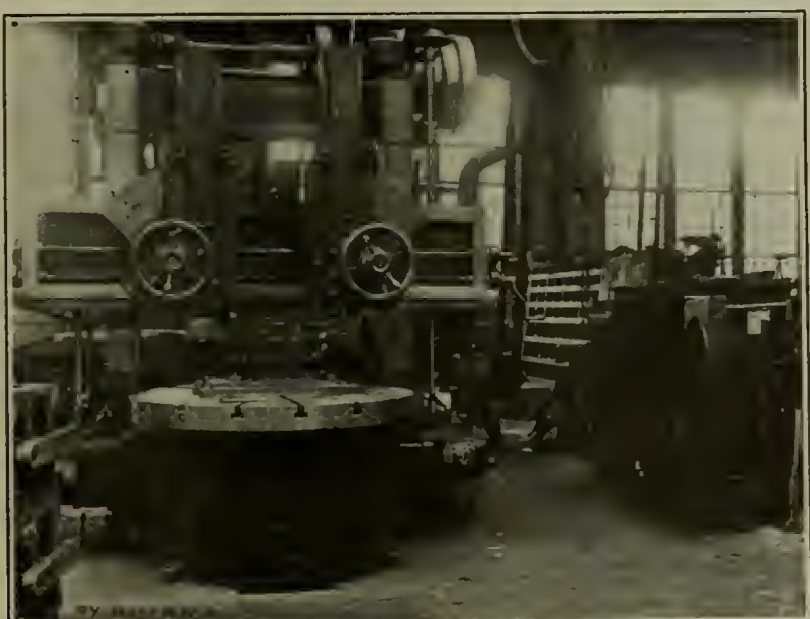
A novel feature of this operation is the corrugated

roughing tool which gives excellent results. In order to make callipering the inside diameter on the roughing cut easy and accurate, the tool is not corrugated for the top half inch, presenting a smooth cut for measurement. The grooves left by the roughing tool are removed by the flat

Rack for Copper and Iron Pipes.

finishing tool. These tools are made from 1½-in. high-speed steel, width and length to fit tool holder.

On this same boring mill, boiler fronts are machined, and new driving wheel centers are finished. Driving wheel centers are secured to the lathe by two special drivers, one of which is shown in the lower right-hand corner of the illustration. The wheel is set on four parallel pieces and the drivers, iron castings with 2-in. bases, have two lugs each, which come up on either side of a spoke. Through the lugs there are set-screws which with



Bullard Boring Mill Rigged to Bore, Turn and Finish Eccentrics Without Removal from Table.

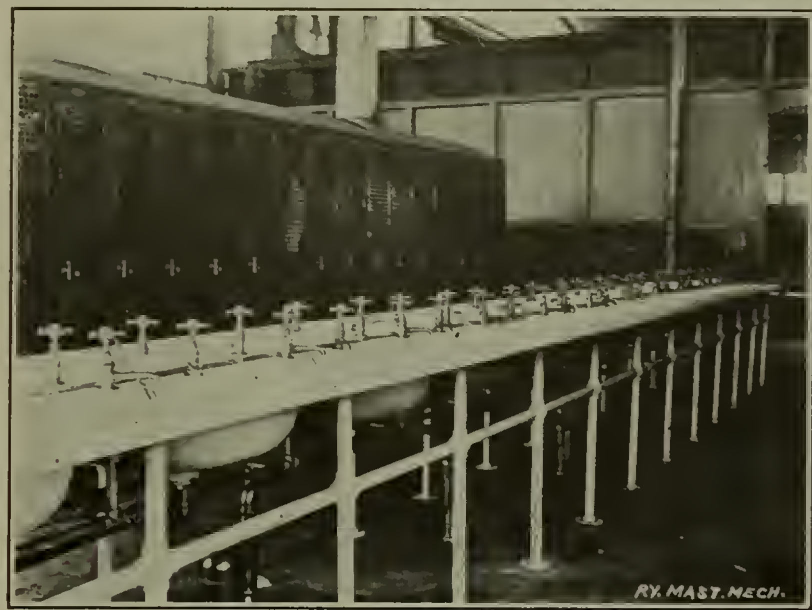
two straps complete the fastening to the table and allow turning and facing of outside rims and hubs simultaneously.

Driving Box Work

Across the midway from the wheel group is the driving box machine group consisting of two horizontal boring machines, used on driving boxes and cylinder bushings, a 36-in. vertical turret lathe for hub shims and driving box liners, a 42-in. boring mill for facing driving boxes, a 5-ft. radial drill for driving box drilling, a draw cut shaper for finishing liners, a 42in. by 12-ft. planer for new boxes and a crank planer for driving box cellars, shoes and wedges. These machines are all driven, from the group motor, through shafting except the two planers.

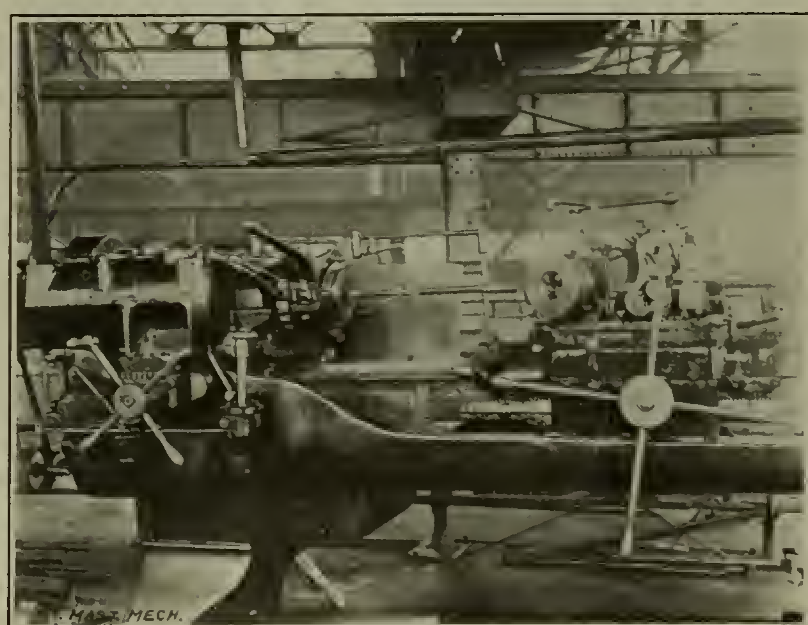
The driving boxes are delivered to the machines from the lye-vat house by the electric truck— and it is shown leaving the lye-vat house with a load of fourteen driving boxes. When the boxes arrive at their destination, they are inspected and necessary material is ordered from the stores department and delivered by them. Linings are pressed out, and new linings are fitted with a Morton draw cut shaper, shown in an illustration. The same machine is used to machine new driving boxes for bearings and cellars.

These new linings are then pressed in on a 50-ton Lucas power press and the shoe and wedge fits are faced



Section of Balcony Locker and Wash Room.

in pairs, right and left. The boxes are then sent to the smith shop and have the brass faces cast on. When they return they are set up on a Lucas boring mill in pairs, right and left, and are bored and faced, and then pinned in. This operation is illustrated by two boxes set up on the table of the boring mill. The time taken to bore, face and relieve two driving boxes, floor to floor, is one hour. There are two of these boring mills in the shop, and other uses to which they are put include boring cylinders, steam pipes, throttle pipes, Walschaerts valve brackets and cyl-



Jones & Lampson Turret Lathe on Stay Bolts.

inder bushings—which last operation is also shown in an illustration.

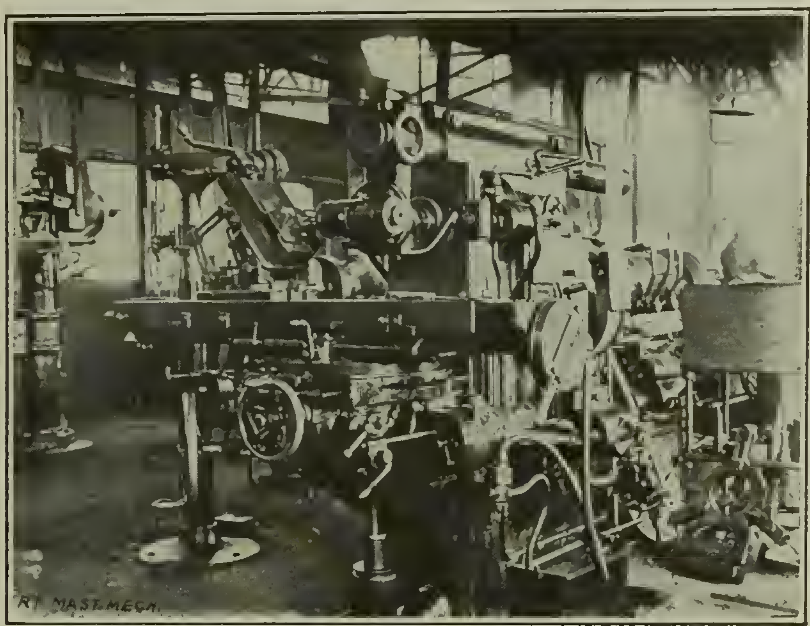
In this group is also the 42-in. by 20-ft. New Haven lathe which is shown turning down a cylinder bushing with two tools—removing an inch of metal. Of course this amount of metal is not turned off as a matter of regular practice, the bushing shown being old stock designed

to bush down compounds from 21 in. to 19 in., which was usable for present equipment by being turned down the amount shown.

While the driving boxes have been put in shape, the wheel tires have been turned and the wheels delivered to the driving box group where the driving boxes are now fitted to the axles and the wheels are ready for the engine to be wheeled.

Link Work

The next group of machines are arranged to handle link work, and embrace a 12-in. slotter and a 24-in. crank planer for shoes and wedges, a 25-in. drill for shoes and wedges and shims, a 33-in. vertical miller for valve motions, a 42-in. by 20ft. lathe for tumbling shafts, a 44-in. drill for drilling guides, an 18-in. by 6-ft. lathe and an 18-in. by 5-ft. lathe, a sensitive drill, a swing grinder, and a link grinder, an 18-in. by 8-ft. lathe and two 16-in. by 8-ft. lathe for link work; all of which receive their power from one group motor. The shafting of this group, the preceding group and the next four groups down the west side of the shop are all lined together and are so arranged that any one shaft could be driven from the shaft at either end, if desired in case of a break down or for any other reason.



Brown & Sharp Universal Milling Machine Making Punch and Die in Tool Room.

One of the features of the link work is the use of case-hardened steel bushings, which are being put into service as fast as engines come through the shop for general repairs.

These steel bushings are bored, turned and faced out of solid bar, the drilling operation being shown. The bars are sawed to length in groups of three, with a circular saw, in a special heartshaped clamp. These blanks are chucked and drilled at the rate of twenty per hour and are reamed on the drill, to the left in the illustration, which now has a crosshead shoe on the table. The bushings are finished and stocked reamed for the standard pin diameter, and some are also finished to one-sixteenth less, so that after a pin wears slightly it can be annealed, turned down and trued up—and will fit the reduced bushing.

The bushings are turned and faced to fit the individual work—and the link group is furnished with portable electric grinders for truing hardened bushings and a grinding attachment is provided on a lathe for grinding hardened pins to fit.

The same drill that reams these steel bushings is used with a special jig to drill cross-head shoes. These cross-head shoes are handled in the shop at a total time allowance for milling, drilling, babbiting and finishing of 30 minutes each. All the cross-head shoe work for the entire system is done in this shop.

Piston Work

The next group of machines is that which takes care of the piston work. In this group are located:

12-in by 72-in. Springfield-Brand guide grinder.
18-in. single-head Cincinnati shaper for piston keys.
26-in. by 12-ft. American lathes for piston rods.
No. 1 Niles Bement Pond piston rod key way miller, all D. C. motor driven.
4-ft. radial Prentiss drill.
30-in. Norton piston rod grinder.
42-in. New Era Bullard vertical turret mill.
No. 4 Becker-Brainerd plain miller.

On these machines all operations included in piston and cross-head work are carried on, without having to send any of the work out of the machine group.

Planer Section.

Opposite the link group and the piston group on the left side of the midway is the planer section containing the following planers—each with an individual reversible motor: a 36-in. planer for frame brasses and link work, three 30-in. by 10-ft. planers, for new guides, valves, cross-heads, covers and rod straps, a 36-in. by 12-ft. planer for steam chests, and a 24-in. crank planer for fitting shoes and wedges.

A Woodward and Powell planer is shown finishing the face of a shoe. Two tools are used, the heads being coupled together, the finishing tool being two inches wide, and having radius on either side for putting round edges on the face of the shoe. The tool feed is one inch per cut and can be quite plainly seen in the illustration, on the rail and by the width of the chips on the shoe. The finishing tool is just completing its last stroke. One man on this planer keeps up with the output of the shop without difficulty. Other work in this department includes all forms of general planing for the rest of the shop.

Boxes and Shelves in Brass Department.

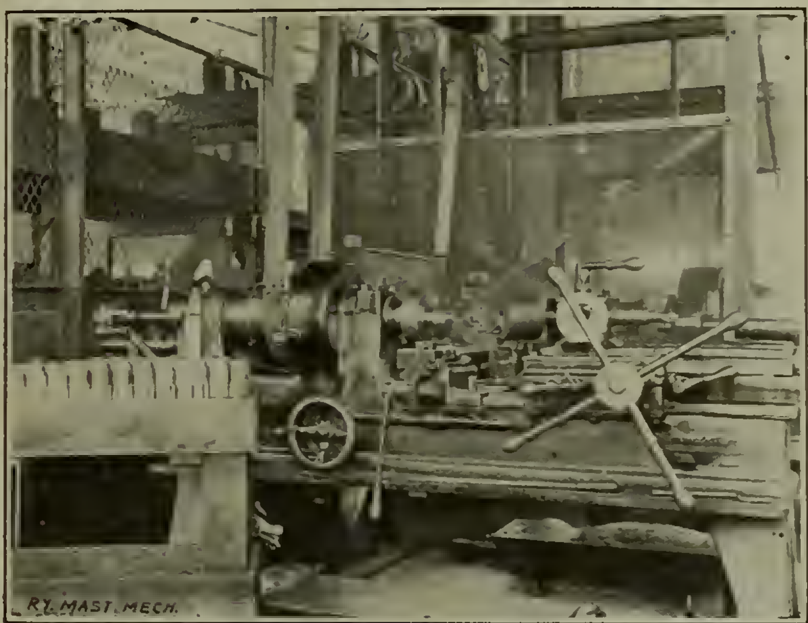
Main Valve and Packing Work

The next group of machines down the right hand side covers the main valve and packing work as well as general lathe work. The equipment consists of a 6-in. bar turret lathe for pins, a 36-in. vertical turret lathe for piston heads and cross heads, a 24-in. by 14-ft. lathe for piston valves, a 26-in. by 12-ft. lathe for yokes and cross head pins, three 18-in. by 8-ft. lathes, for piston rod packing, fitted pins and guide blocks on bell work, a centering machine, a 24-in. boring mill for air pump packing and

valve chamber packing, a 36-in. vertical turret lathe for air pumps and packing rings, and a 4-ft. radial drill for general drilling.

Work carried on here includes valve yoke, piston valve, piston rod and valve stem packing, and miscellaneous lathe work, etc. Cylinder valve packing rings are made on a Bullard boring mill.

The machining of a tank valve on a Bullard Vertical Turret Lathe equipped with an adjustable angle iron is shown. All the finishing except drilling and tapping for studs is completed on the one machine. The operations are: Facing for tank connection, drilling for valve spindle, bevelling seat for valve, facing for goose neck.



Warner & Swasey Brass Lathe Making McLaughlin Conduits in Four Operations.

Rod Work

Imediately south of this group is the equipment for making and repairing rods, which includes: A 48-in. by 14-ft. horizontal mill machine for making new rods, a vertical milling machine for rod brasses, a 24-in. vertical turret lathe for rod bushing, a 44-in. drill for drilling and reaming rods, a 20-in. by 8-ft. lathe for knuckle pins, an 18-in. by 8-ft. lathe for rod bolts and pins, a 25-in. by 12-ft. lathe for pins and rod bushing, a double end rod borer and a 24-in. by 10-ft. lathe for general work, pins, etc.

An illustration is shown of a No. 6 Becker Brainerd vertical miller with an 18-in. by 49-in. platten milling bottom and top of flanges back-end main rod brasses at one operation—with four brasses set up at once. The table feed runs from 18 to 20 inches per minute and the cutter speed is 275 feet per minute. The first cutter shown on the table of the machine completes the operation by finishing the insides of the flanges. Other cutters for facing are also shown. These cutters of the inserted tooth type for use on brass have been developed in this mechanical department.

In this group all rod bushing are turned and fitted on a Bullard Vertical Turret lathe—one machine taking care of all of this work for the entire shop. Bushings are pressed on a 30-ton Lucas power press and then bored on the Baker double end rod borer to fit crank pins. This rod borer is equipped with separate motors for each head and an air clamp holds each head at the required center.

Drilling, Slotting, Shaping, Turning and Planing

Opposite these last groups of machines on the left hand side of the midway is a large group of machines which take drilling, slotting, shaping, turning and planing work from the right hand side of the shop and from the erecting bay. The machines here are divided between two motors through shafting and consist of the following: a 15-in. slotter for rod work, a 42-in. vertical miller for rods, a 24-in. crank planer for fitting rod boxes, a 40-in. drill for reaming rods and drilling new rods, two 24-in. shapers for rod keys and wedge work, a 12-in. slotter for spring rigging and eccentrics, a 24-in. by 10-ft. lathe for general work, a 6-ft. universal radial drill for cylinder work, a 54-in. planer for eccentrics, straps, and general work, and a 6-ft. radial drill for frames and general work.

One of the machines in this group as illustrated is the 42-in. Niles Bement Pond Vertical miller, with individual motor drive and crane attachment. The work shown is milling around the front end of a main rod. The same machine mills the back ends of main rods and the ends of all side rods. This miller can also be rigged for continuous milling of back end main rod wedges, and new Walschaerts links are made here.

Included in this group is the 54-in. by 10-ft. Niles Bement Pond reversible motor drive planer shown planing the flats of back end main rod straps. Eight straps are set up at a time and two tools are used simultaneously.

First Floor Tool Room

Against the right hand wall is located the first floor tool room in which are stored and from which are issued all hand tools and tool steel. All grinding, dressing, and heat treating of tools is done here, and the dressing and heat treating outfit is illustrated. The furnace on the left is connected to a pyrometer shown on the back wall, and the oil quenching bath has a large thermometer. On the right is shown a motor driven 66-lb. Beche Nazel air hammer. Other tools are as follows: a universal tool grinder, a cutting-off machine, a cutter and reamer grinder, a grinder for milling cutters, two drill grinders, an air hammer, a tool fire, an oil quenching-bath, and a power squaring shears.

Air Brake and Tender and Engine Truck Drilling

Next beyond the crossover on the right is the air brake and tender and engine truck drilling group containing the following machines: Three 44-in. drills for break rigging

Belt Man's Location Board.

and general work, a 20-in. shaper for air brake keys, a 6-ft. radial drill, a 25-in. drill for engine and tender work, a 5-ft. radial drill for engine and tender truck work, a 20-in. by 8-ft. lathe for squaring nuts, and a 24-in. crank planer for engine truck boxes, and cellars. A scuttle in the gallery permits of bringing all heavy borings quickly and easily from the air brake department in the gallery to these machines.

A 44-in. Foote-Burt drill is shown working on spring

and brake rigging. An 8-in. brake cylinder has been fitted to the drill to clamp the irregularly shaped pieces of rigging to the table. A gear pump for oiling the drill has been fitted and aids materially in increasing the capacity of the machine.

Near this work is the pipe repairing department, and a tender and truck bearing babbitting outfit. A rack made at the shop for iron and copper pipe is shown as well as the bench for pipe work.

Frame Work

Across the midway from this work is the frame department including the following: two 20-in. traveling head Dill slotters, a 72-in. planer for frames and cylinders, and two portable bolt lathes that are motor driven and are used in fitting frame bolts in the erecting shop, and for small lathe work in the machine shop. With this work is grouped the electric welding department in which a variety of work, both large and small, keep four operators constantly employed. A large amount of welding work is done by the thermit process in the erecting shop without removing the broken parts unless necessary in rigging the apparatus.

Pipe Machines.

Beyond the air brake and drilling and boring group are two more drills and a boring machine and a group of pipe machines doing general work and consisting of the following: a 40-in. drill, a 51-in. boring mill for engine truck centers, a 3-in. and a 4-in. pipe threader, a 36-in. drill, a 32-in. drill, and a 20-in. drill for engine truck, engine, tender truck, and general drilling, a 54-in. planer for engine truck spreaders and boxes, and a 6-ft. motor driven radial drill for boiler shop work. The Bullard boring mill, illustrated, is rigged to bore and turn and finish eccentrics without removing them from the table. On this machine eccentric straps are also bored as well as air pumps and cylinders rebored and engine and tender truck center castings.

This completes the layout of the machines on the main floor. The south third of the west bay is devoted to the boiler and flue work previously described.

Gallery

On the gallery, starting again at the north end, is a wash and locker room, a view of part of which is shown. There are three of these rooms in this shop, containing about 800 lockers.

Walking south along the gallery the next section is the headquarters of the painters, though the actual work of painting is carried on throughout the shop wherever the work may be.

Turret Lathe Work

Next south is the turret lathe department in which are the following machines: two 3-in. by 36-in. and three 2-in. by 24-in. flat turret lathes for pin and bolt work, a 2½-in. screw machine for set screws and a drill for pin work. All of these get their power from one group motor. The illustration shows a 2-in. by 24-in. Jones and Lampson turret lathe turning and threading, finishing complete a button head radial stay bolt, which has been delivered from the smith shop. Stud and bolt work is done here, as well as piston and valve stem, and vibrating cup work. By-pass valves, packing and rings, glands, etc., are finished.

Carpenter Shop

In the carpenter shop which is next south, the cab work is done. The machines are a buzz planer, a combination saw and a band saw, all operated from the turret lathe motor. The ten ton cranes that serve the heavy machine bay can lift cabs or other material within their capacity over the gallery railing to the gallery floor.

Gallery Tool Room

Next comes the gallery tool room in which most of the machine work and manufacturing on tools is done, as well as repairs made to hand tools, etc. The machines, all driven by a group motor, include: two universal milling machines and a plain milling machine, a 14-in. lathe, an 18-in. lathe, a 20-in. by 10-ft. lathe, a sensitive drill, a 32-in. drill, a 14-in. pillar shaper, a 36-in. lathe for jig work, a grinder and buffer, an 18-in. by 6-ft. lathe, an 18-in. by 8-ft. lathe, a 20-in. by 12-ft. lathe, a 26-in. by 12-ft. lathe, an a power hack saw.

A Brown and Sharpe universal milling machine, of which there are two, is shown making a punch and die for squaring the ends of stay bolts, before threading.

Sheet Iron Work

Beyond the tool room is the sheet iron and jacket work department, equipped with a power squaring shear driven up through the floor from the air brake group motor below.

Brass Work

South of this room is the brass department in which all the work on cab brass work, pumps, triple valves, distributing valves, injectors and air brake operating parts are repaired.

These brass parts are all put in a box when taken from the locomotive and this box is lifted by a traveling electric hoist over the gallery, up through a scuttle and stored in racks in the boxes illustrated, each bearing the engine number of its parts, until they are returned to the engine.

In this department the machines are: a bench grinder, a valve grinder, a tool grinder, two 19-in. and three 16-in. brass lathes for new valve work and small brass work, a 32-in. drill for general brass drilling, a 20-in. drill for air pump drilling, a 16-in. sensitive drill for brass work, three 18-in. by 8-ft. lathes for safety valves and general brass repairs, a 24-ft. by 10-ft. lathe for aim pump repairs, and a speed lathe built in the Concord shops.

The Warner and Swasey 16-in. brass lathe illustrated is making McLaughlin conduits complete, turning two diameters, drilling and threading. This department does the link work—oil cups—rod oil cup bushings, steam gauge fittings, suction hose nuts, copper pipe nipples, as well as all brass inserts for piston rod and valve stem metallic packing. The power for this work comes from a group motor.

Beyond the brass work is the air brake bench and the test rack.

At the south end of the gallery the belt man has his headquarters, while a board outside the general foreman's office indicates, as can be seen in the illustration, where he is working, and the next place or places that he is wanted.

Organization

The organization of the machine shop includes next under the general foreman, one machine foreman, with four assistant foremen: one, supervising link, piston, main valve and general machine work; one, the lower drilling and planer and rod work; one, the wheels, boxes, shoes and wedges; and, one, the two tool rooms; gang leaders are in charge of the various groups of machines. One boiler shop foreman has two assistant foremen, one on each side of the erecting bay—also gang leaders in charge of flue work and fire box work. The erecting shop foreman has as assistants the stripping forman,

four repairing gang foremen, the air brake foreman, cab work foreman, foreman painter, and an engine truck and tender foreman, as well as gang leaders.

Two engines per day are usually put into the shop and two a day finished, and the average length of time for general shopping, which does not include heavy boiler repairs, is eleven to thirteen days.

Schedule

The work going through is scheduled. The beginning of the system was mentioned when the engine was being stripped. Copies of this schedule giving dates for the completion of the repair work are given to the general foreman, the machine foreman, the erecting foreman, the boiler foreman and to the erecting foreman's assistant, in whose charge the engine is repaired and assembled, and to the office. A similar schedule covers the boiler work.

In the general foreman's office a board has vertical columns for dates, and horizontal lines representing the same stages of progress used on the schedule. These can be referred to the center of the board easily and accurately by means of a horizontally sliding runner. Every engine in the shop is kept checked up on this board and the date in and out of the shop is recorded.

With each repair item as it is delivered to a gang leader goes a schedule slip on that particular item, so that there may be no misunderstanding or discrepancies in the repairs being completed to accord with the schedule.

Every morning a report of the day's failures to keep up to schedule is placed before the foremen and the office by the schedule man, with the reason for the delay indicated by the man in whose charge the work is delayed.

In addition to these, the foremen have a weekly calendar prepared in advance of the locomotives in the shop and their dates due out. There are also cards showing daily engine movements, covering locomotives arrived, locomotives turned out and locomotives due to be delivered.

The shop is unusually well planned to avoid unnecessary movement and counter movement of material. As a generality, it may be stated that parts to be repaired go from the lye vats to the machine group where they are to be repaired, where all necessary machines are located to finish the repair and make it possible to deliver the finished part directly to the locomotive. The midway is wide and clear. The shop is well lighted and ventilated beyond most shops of any nature. The machines are new, with the exception of one for which it was felt that no modern equivalent was being manufactured. The quantity of work is great enough to warrant much specialization of machinery that makes for very economical practice. The operation of the shop has the buoyancy and enthusiasm of youth and its direction and guidance has maturity and judgment of experience. The effect of this has a distinct commercial value which cannot be overlooked in these times, when rigid economy is the order of the day. The good feeling prevalent in the Billerica shops undoubtedly produces a feeling of loyalty, which appears in various forms of service, all of which are for the benefit of the company. The saying "Like master, like man," has here a concrete exemplification, and it is to the spirit of the men in charge of a large plants that one has a right to look for the quality of the output.

The writer wishes to express his appreciation of the courtesy and helpfulness of the superintendent of motive power, Mr. C. H. Wiggin, and the superintendent of shops, Mr. Thomas Jennings, and was also greatly assisted in gathering his material and data by the assistant superintendent of shops, Mr. H. T. Nowell, and by the foremen under whose direct charge the various departments of the shop are ably operated.

MECHANICAL STOKERS

The subject of "Mechanical Stokers," by Mr. W. L. Robinson of the Baltimore & Ohio, was scheduled to be read at the annual convention of the Traveling Engineers' Association, but it was not presented at that meeting. We have, however, drawn this brief summary of his very valuable paper from the advance sheets published by the association.

With the scatter system of firing a locomotive that is spreading the coal in small increments as required over the entire grate area, a condition is established which makes for better combustion and, while there may be very little difference in the percentage of smoke per hour as compared with hand-fired locomotives, the smoke density will remain more uniform with the stoker-fired locomotive and not come up to the density of smoke often produced by hand firing.

The application of mechanical stokers to locomotives has made it possible for any fireman to handle any locomotive, regardless of the manner in which it is worked, whereas formerly it was beyond the physical endurance of the majority of the firemen to handle large locomotives when worked to full capacity. This has been fully demonstrated on the 2-10-2 type of locomotives.

By the use of the mechanical stoker the fireman is able to follow his engine more regularly, he makes correspondingly more money and, as a result, he is better satisfied. This is a condition which makes it less difficult to keep a locomotive in service than it otherwise would be, especially on a division where the conditions of firing are particularly severe and the overtime runs high, due to having to relieve the firemen in the hot summer months.

By the use of the mechanical stoker it has been found possible to fire even the largest locomotives when they are worked to maximum capacity, and to use a poorer grade of fuel than is possible in any small size locomotive when hand-fired. This must necessarily make for economy in fuel cost, per ton mile. On a number of roads this cheap grade of fuel is purchased especially for stoker-fired locomotives, and on other lines where conditions are such that small run-of-mine coal is supplied, an economy is effected in that the run-of-mine coal is screened and the percentage of poor coal is set aside for stoker-fired locomotives, leaving a much better grade of coal for the hand-fired locomotives.

As to actual fuel economy due to the application of mechanical stokers under the same working conditions as locomotives not equipped with stokers, there is practically none. However, there is a great saving due to the fact that the records show that inferior grades of coal can be used and increased tonnage handled and in less time than it was possible to handle with the same class of locomotive when hand fired.

The Westinghouse Electric & Mfg. Company announces the following more important among the large number of awards received at the Panama-Pacific Exposition. The Grand Prize, which is the highest award, on the 4,000 h. p., 650-volt, d. c. double unit Pennsylvania electric locomotive mounted on a turntable under the dome of the Transportation Palace. The Medal of Honor on alternating current and direct current industrial motors and control apparatus, on precision instruments, on Le Blanc condensers, on motor-generator sets for moving picture machines and on high voltage oil switches. The Gold Medal on a number of different classes of apparatus among which are steam turbines, alternating and direct current generators, alternating and direct current railway motors, transformers, rectifiers, starting, lighting and ignition systems

Some Old-Time Rogers Engines

By Arthur Curran

Among the locomotive builders who were famous prior to the era of "mergers" whereby many plants were brought under one management, Rogers was one of the best known. The man himself was a remarkable personality, and his engines were characterized by a certain individuality throughout his management of the works that bore his name. These characteristics persisted as long as the plant enjoyed its independence, and were a source of interest and pride to those who understood and helped to make them.

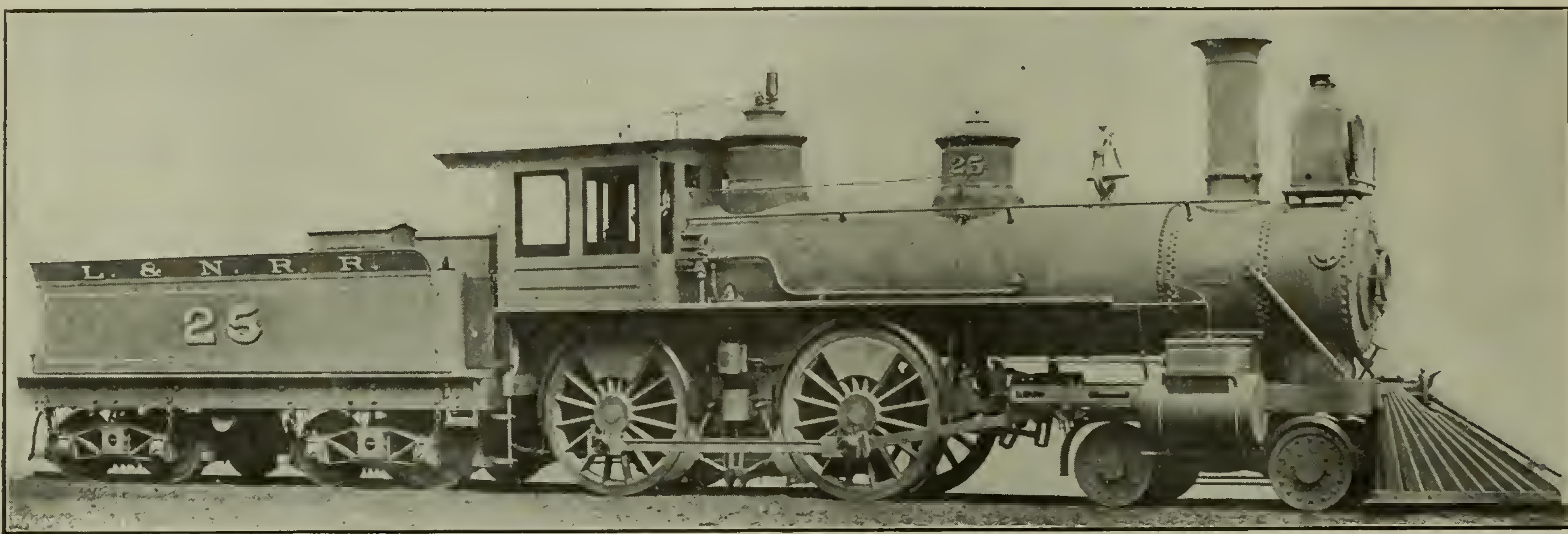


Fig. 1. Engine of the 4-4-0 Type, on the L. & N.

Rogers engines were known all over the United States, but appear to have appealed particularly to Southern roads, and many of the handsomest locomotives were built for them. Oldtime builders usually tried to make their engines as attractive as possible. Railroads encouraged the practice, for they were partial to nicely proportioned machines. As might be expected, passenger engines reflected this tendency more than other types.

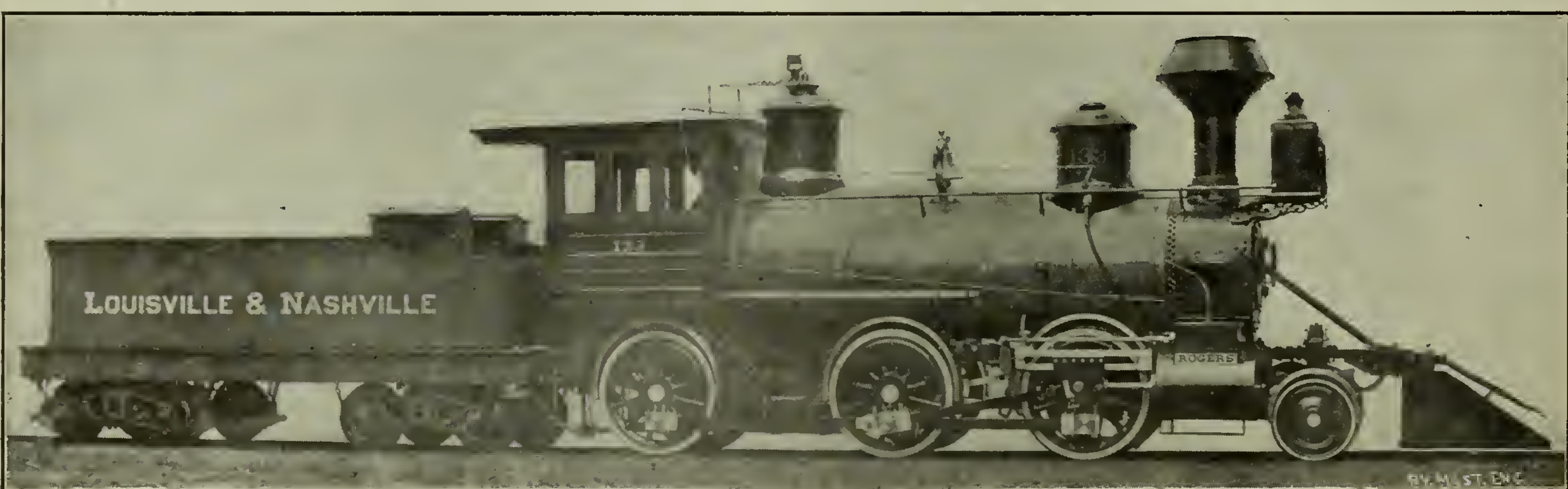


Fig. 2. Mogul Freight, 2-6-0, on the L. & N.

The oldtime engine is of interest as a contrast to the enormous locomotive of today. The people interested include not only railroad men, young and old, but men in all walks of life. The writer has derived information from a large correspondence, and a very careful investigation extending over a number of years. Sometime ago, the writer had the good fortune to obtain a collection of photographs of Rogers engines, and four of them are reproduced here. Unfortunately, the exact dimensions of these engines are not available, but the pictures "tell the story."

Fig. 1 shows engine No. 25 of the Louisville and Nashville Railroad. This is an excellent example of the standard eight-wheel passenger engine or 4-4-0, as built by Rogers. The "cap" stack was a favorite Rogers design, as were also the designs of sand-box and dome casing, and also the style of cab. Although equipped with air-brake apparatus and I-section connecting rods, the engine was probably built a generation ago. This engine also illustrates the well-proportioned design for which the builder was once famous, and which the railroader of the "old school" will readily recognize.

Fig. 2 shows a Mogul freight engine, 2-6-0, of an earlier period and built by Rogers for the same road. It will be observed that this engine had the oldtime widemouth diamond stack and short non-extension smoke box front, together with the familiar Laird cross-head then popular on this type. The engine was No. 133.

The locomotive shown in Fig. 3 is, in some respects, the most interesting of the lot. This engine, No. 282 of the Louisville and Nashville, is of the Consolidation, or 2-8-0 type. Its antiquity is proved by the absence of air-brake apparatus, and by the fact that the main rods are connected with the second pair of drivers instead of the third, according to modern practice. This engine was

equipped with a Belpaire fire-box. This is unusual for such an oldtime engine, and suggests the possibility that it was one of the earliest to be so fitted. Furthermore, the throttle stem was carried through a sleeve extending over the top of the boiler to the dome. This latter practice enjoyed considerable favor long afterward. It was later abandoned, only to recur within recent years, though in a somewhat modified form. It is one of the curious, as well as interesting, features of motive power history that details of design that were tried years ago reappeared some time later.

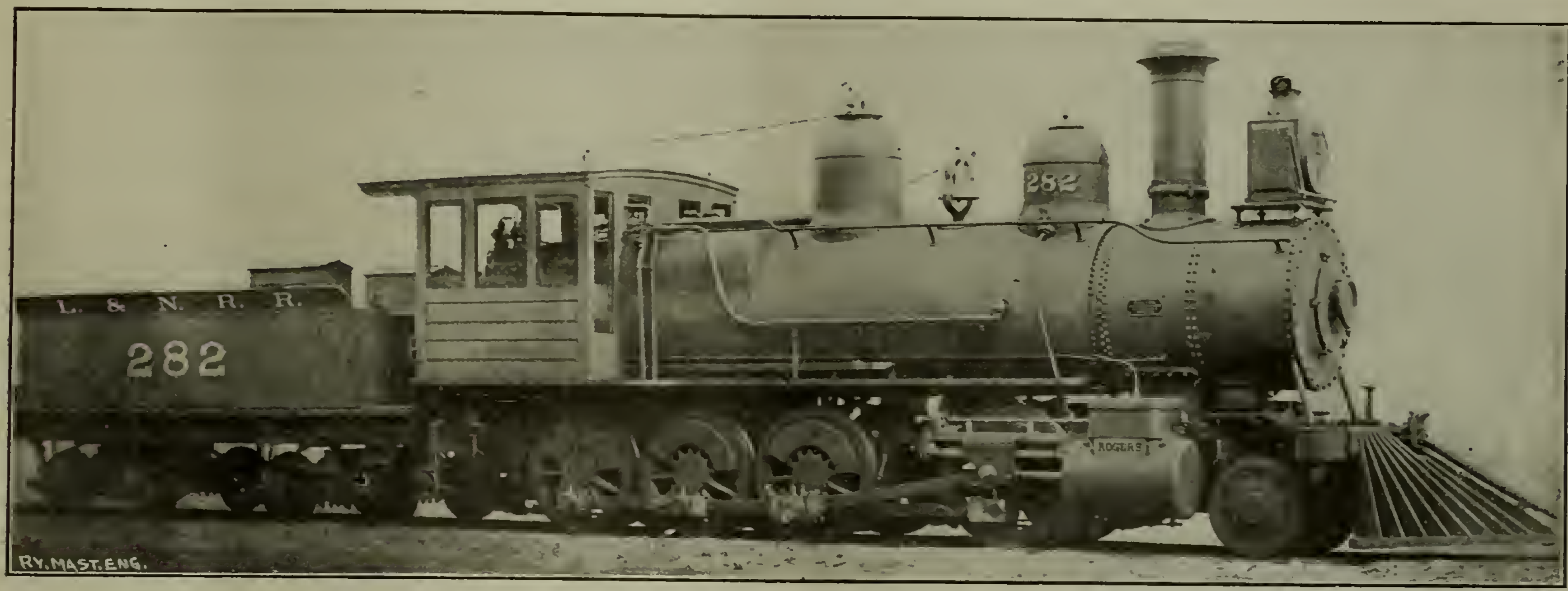


Fig. 3. Consolidation, 2-8-0, on the L. & N.

Fig. 4 shows an engine of the same type and general design as that in Fig. 1; viz: 4-4-0. It is No. 30 of the Western Railway of Alabama, and is included here to illustrated the fancy cab, possibly specified by the road, and the very neat design of steam chests. The bell on this engine was operated by a rod instead of cord. This is, of course, but a minor detail, and may have been intended to insure positive action, or to eliminate wear or loss of cord.

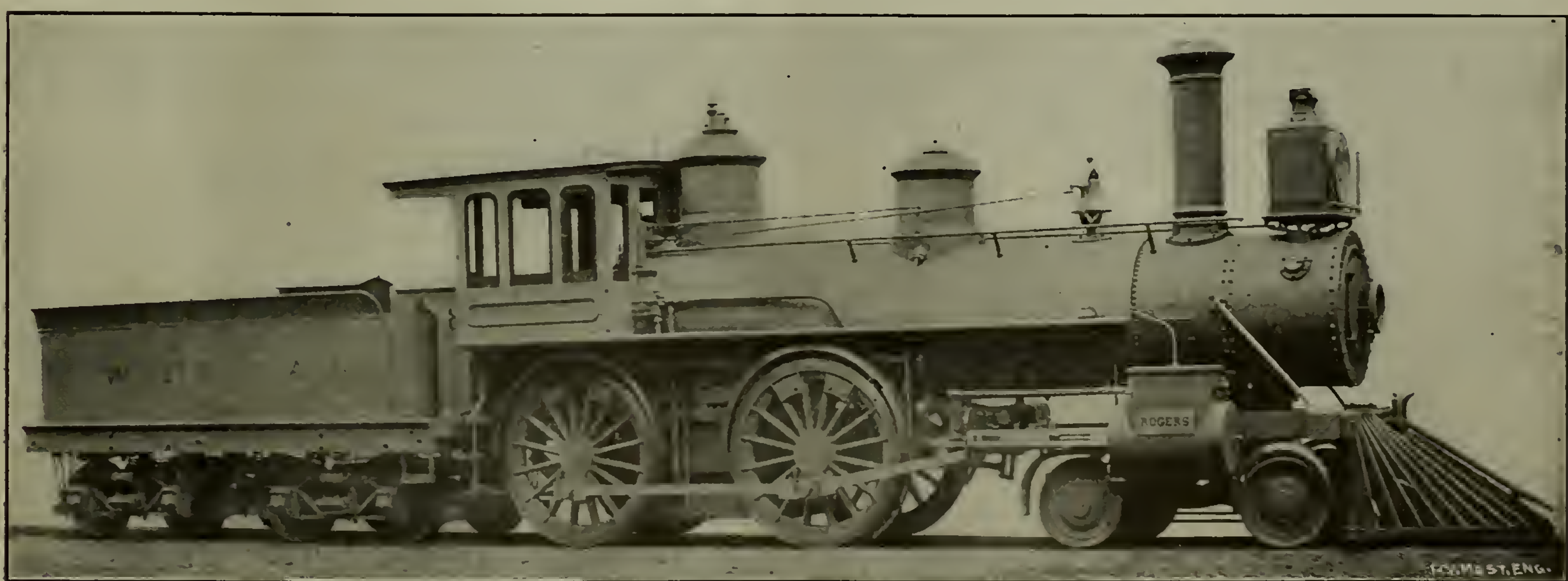


Fig. 4. Western Railway of Alabama 4-4-0 Engine.

As the eight wheeler was the favoriate type for many years and became a very handsome machine, it is only fair to give it some prominence. In addition to its value as a trustworthy and highly serviceable type, it will be remembered that the cost of maintaining and operating it was then not very high. Oldtime railroaders often sigh today when they compare the figures for this and for modern types.

In concluding this brief survey of former-day types it would be well to direct attention to the commendable desire of young men to be up-to-date. It is worthy of encouragement. The young worker may yet be glad to know that the old "boys" got along pretty well before he "came on the road," and that the engines which they fired, ran and repaired were good in their day, and that they met the conditions then prevailing and helped to build up the road.

Railroads were not built in a day. They represented struggle, work and achievement. Railroads have a history, and a good one, at that!

NEED OF RAILWAYS

The efforts of the provincial governors to secure funds for the various sections of the Canton-Hankow line are reported to be meeting with fair success, says a recent Commerce Report. Although the first effect of the European war was to bring to an abrupt close all construction work on Chinese railways financed with foreign capital, a later result has been to stimulate Chinese provincial officials to raise funds with which to build the necessary lines themselves. This movement may bring about in a large measure the financial independence of China, so far as foreign financial aid is concerned.

ALLEN AND STANDARD TIME

The death of William Frederick Allen, formerly general secretary of the American Railway Association, at this time calls attention to the importance of the good work with which his name is inseparably connected. It was the bringing into use what is so familiar to us all—Standard Time. In this highly beneficial field of useful endeavor, Mr. Allen gained a world-wide reputation and wrote his name high on the honor role among the men who achieve.

William Frederick Allen.

Perhaps the most practical advance for the people of the United States has been in the establishment of standard time. and its use has followed the sun in nearly every country on the globe. The history of this achievement, which is Mr. Allen's work, reads like a romance. Standard time in the United States and Canada is secured by the division of the continent into four zones which lie between five meridians. The first is 60 degs. west of Greenwich, England. This meridian passes through Louisburg, on Cape Breton Island, in Nova Scotia, Canada. It gives "Atlantic" time. Fifteen degs. west of this is the 75th meridian west from Greenwich, which gives us "Eastern" standard time. The next is 90 degs. west, for "Central" time, then the 105th meridian gives "Mountain" time and the 120th meridian west from Greenwich sets "Pacific" time. Between these five meridians lie the four zones. Each meridian is 15 degs. apart, or a distance about equal to 96 miles at the equator, and of course much less at the international boundary between the United States and Canada. The time change at each of these specified meridians is exactly one hour. By this means, when it is 12 o'clock noon at Louisburg, N. S., it is 11 a. m. at New York. 10 a. m. at Chicago, 9 a. m. at Denver, and 8 a. m. at Vancouver, B. C.

The use of divisions of space, to approximate to some kind of uniformity in time measurement, first occurred to Sir John Herschel in 1827. Prof. Benjamin Price in 1873 proposed to mark time by meridians west from Greenwich selected them 15 degs. apart. Prof. F. C. Dowd, of Saratoga, in 1869 proposed a system applicable to railroads and divided the country into four zones. He proposed a retention of local time, the railroads only being affected. This system required plus and minus signs for local and meridian time. In 1875 Sir Sandford Flemming then chief engineer of the Intercolonial Railway of Canada, proposed a thoroughly workable arrangement of universal time. His theory rested on the hour difference for localities and was applicable to the whole world. Under his scheme if 12 o'clock was selected for the noon hour in London, the "noon" hour for New York would show on the clock as VIII, and the whole New York clock dial would have to be turned to make VIII the uppermost figure. The scheme was workable, but custom was too strong for so sweeping a change. He, however, introduced the 24-hr. clock used on the Intercolonial Railway, the C. P. R. lines west, and this has extended to the population of the western part of Canada. Dr. Thomas Hill, former president of Harvard University; Cleveland Abbe, Dr. F. A. P. Barnard and Mr. E. A. Hill followed with theories for solving the problem, but none of them met with the approval of railroad men.

In 1881 the General Time Convention met in New York and the American Metereological Society laid before the convention a proposal for a single standard for the whole country. The hour theory was suggested as an alternative proposition, and the matter was then placed in the hands of Mr. William Frederick Allen, then secretary of the convention, with instructions to report at the next regular meeting. Mr. Allen had been a practical railroad man and had been working for ten years on his own theory of standard time which would meet the railroad situation and cause the least disturbance to existing conditions.

At the time the matter was placed in Mr. Allen's hands, there were fifty-three railroad time-standards in use. On long lines having a general east and west trend, such as those of the United States and Canada, it was necessary to alter the railroad standards at various points, when the difference between local and railroad time became too great. Mr. Allen presented the then existing conditions on a map at a meeting of the General Time Convention at St. Louis, April 11, 1883. The points where the railroads changed time were, of course, arbitrary, but when shown on a map they presented a crude and haphazard and wholly inadequate attempt at uniformity. The change being generally made at some large city, or divisional headquarters, or at a point convenient to the railway and without reference to any scientific conception of time-marking or regulation. Mr. Allen showed the advantages of standard time as we know it, and how the local and standard time difference could never exceed thirty minutes. Under his system this difference entirely disappeared with the abandonment of local time.

He further showed that Greenwich time was the uni versal time standard for all vessels at sea, and therefore any system proposed for use on land must bear some definite and tangible relation to the well-established sea time—the ocean standard of the world. He selected the 60th, 75th, 90th, 105th and 120th meridians west of Greenwich as the fixed meridians for standard time in the United States and Canada. In this way Greenwich time came to be adopted on this continent. It was this broad-minded and scientific view that lead to the adoption of a system that admirably dovetailed into existing conditions and produced the least disturbance, while having the greatest advantages. The scientific use of the Greenwich standard by the United States was the reason for the still further adoption of Greenwich time by all the foremost nations of the world.

Mr. Allen encountered the greatest opposition from high and low in having his epoch-marking system adopted, but finally by the inherent common sense of the plan, backed by the indomitable perseverance of a strong, clear-headed and kindly personality, the new standard time system was adopted. When it came to be an accomplished fact there was little that was spectacular about the change. It was a spontaneous and simultaneous movement of the whole people all over the country, wisely directed, for the common good. Mr. Allen thus described the scene as it was at New York:

"On November 18, 1883, the ball on the tower of the Western Union Building in New York City dropped, for

the first occasion in its history, on Sunday. Standing on the roof of that building, about a hundred feet from the tower, in the midst of a little group of interested spectators, I heard the bells of St. Paul's chapel strike on the old time. Four minutes later, obedient to the electric signal from the Naval Observatory at Washington, 240 miles away, the time ball made its rapid descent, old Trinity rang twelve measured strokes, and local time was abandoned, probably for ever."

As an example of how the work of standardizing time has steadily gone on, it is interesting to know that through the centre of the famous mosque of St. Sophia at Constantinople runs the theoretical meridian which gave the Turks true local time, which was 1 hr., 56 min. and 53 sec. faster than Greenwich time. Several years ago the government adopted the standard system of time zones and went into the Eastern European zone, exactly two hours ahead of Greenwich time.

In Europe it is Ireland, Greece, Holland and Portugal that still use local time. Russia uses St. Petersburg time, which is two hours and one minute faster than Greenwich time. This is practically standard time. In Asia, Japan and the Philippines, Greenwich time is used—that is, the time of their prime meridians differs from Greenwich by even hours. British India and European colonies in Africa use standard time. In South America, Peru, Chili, Columbia and Equador, use standard time.

The work of Mr. Allen, which was, in essence, the taking hold of established ocean time from the older of the English-speaking peoples, and adding to its operation the continent on which he was born, he thus produced the far-reaching effects his vision gave. His efforts in the practical elimination of local time have made his scheme of time reckoning now but a commonplace of life to us. It was the further harmonizing of railroad and local time, making a standard system that has been of universal good. These are the things for which Mr. Allen's name is so widely known and will be so gratefully remembered. With becoming modesty, he sought not to place his name upon his noble work, as lesser men might do. It remains "standard" time, but the historian will speak but truly, in bearing witness to his work. The great five earth-encircling meridians that he chose for us are like those "Jewels, five words long, that on the stretched forefinger of all time, sparkle forever."

SOME CAUSES OF HARD RIDING OF PASSENGER CARS

By Frank J. Borer, Foreman Air Brake Department C. R. R. of N. J., Elizabethport, N. J.

One of the requirements to make travel on a railroad as comfortable as possible is easy riding cars. The mechanical engineering departments of the railroads are always striving to use every reasonable means for increasing the safety and comfort of the traveling public and therefore trucks are designed to assure easy riding cars. But as the trucks and the bodies of the older type of cars need repairs and sometimes rebuilding, changing of wheels is constantly taking place, and some parts become considerably worn and "hard riding" creeps in.

It is not always easy to find the cause of the trouble, and this article is written with a view of starting a discussion of mutual benefit to those in charge of this work.

1. One of the most common causes of hard riding on four-wheel equalized type of passenger car trucks is insufficient clearance between truck side sill and equalizer, generally due to equalized springs being too short or too weak.

2. Elliptic springs being too weak or some leaves broken, causing the leaf bands to strike one another.

3. Elliptic springs too strong, causing too much swinging when car is rounding a curve at moderate speed and absorbing, only partly, the slight shocks due to car running over uneven track.

4. Insufficient clearance between truck side sill or equalizer and elliptic springs, or insufficient clearance between pedestal straps and equalizers or journal boxes. Elliptic spring leaves being too rigid due to little ridges being on top of leaves on account of continuous friction of corresponding leaves, thus destroying the free movement of the leaves.

5. Journal boxes fitting too tight in pedestals, preventing the free movement of truck frame. Loose pedestal bolts will have a similar effect on curved track.

6. Ends of brake beams interfering with the free movement of truck frame by striking the helical or equalizer spring seat casting. Truck lever connecting rod striking the spring plank.

7. Wheels out of alignment in relation to the truck frame, due to there being a new pedestal or a new journal box applied on one side of the truck, while these parts on the other side of truck are badly worn, thus causing the wheel having the worn journal box and pedestal to crowd against the rail. This defect will also cause undue flange wear and hollow worn tread of one wheel excessive journal collar wear and end of journal brass wear on opposite side of truck. Another bad effect is uneven wear of brake shoes, loss of brake shoe metal as well as loss of braking power.

8. A bent journal will always cause a car to ride hard. This defect is one of the most difficult to discover. A defect similar to a bent journal may be caused on the wheel lathe when turning the wheels if the gripping clamps of lathe are unevenly adjusted or should slip, throwing most of the side strain upon one clamp. Therefore if wheels are turned with unequally distributed side strain, it is likely that they will cause hard riding because the defect will act as a bent journal would act.

SOME INTERESTING LOCOMOTIVE FIGURES

A little bit of interesting and instructive mathematics was given at a New York Rairoad Club meeting by Mr. L. R. Pomeroy, Eastern Manager of the Car Lighting Department of the U. S. Light and Heat Corporation. The figures produced tend to show that mechanical stoking is necessary in order to get the full capacity of large modern locomotives. The use of the wide firebox, he said, was a more rational arrangement of the parts in modern locomotives and had done much to increase capacity and produce economical results.

The speaker took three locomotives as typical of modern practce. They were a P. R. R. 4-6-2, a B. & O. 2-10-2, and an Erie 2-10-2 engine. A table of dimensions he gave is quoted, as follows:

No.	Item	4—6—2 P.R.R. class K—4s 1	2—10—2 B. & O. 2	2—10—2 Erie 3
1	Weight on drivers, lbs.	200,000	336,800	327,250
2	Tractive force, lbs.	41,000	84,500	83,000
3	Diameter of drivers, ins.	80	58	63
4	Boiler pressure, lbs.	210	200	200
5	Cyl'rs, diam., stroke, ins.	27×28	30×32	31×32
6	Evap., h.s., sq. ft.	.....	5,573	5,801
7	Superheat, h.s., sq. ft.	.....	1,329	1,377
8	Equiv., h.s., sq. ft.	5,766	.....	.....
9	Grate surface, sq. ft.	70	88	88.1
10	Horsepower by approx. formula (boiler pres.) × 0.017 × (cyl. dia.)	2,600	3,000	3,200
11	Horsepower from diagram	2,700	3,100	3,100
12	Tract. force at 60 m.p.h. (for 4-6-2)	15,700	.....	.....
13	Tract. force at 35 m.p.h. (for 2-10-12)	.....	34,500	34,000

14	Piston speed at 60 m.p.h.......	1,180	.....	.....
15	Piston speed at 35 m.p.h.......	.....	1,080	1,000
16	Coal per hour at rate of 2.7 lbs. coal per hp. hr. given by Mr. Henderson as appropriate for superheat of 200 to 250 deg. F.	(2,600 hp.) 7,020	(8,100 hp.) 8,100	(3,400 hp.) 8,640
17	Coal per hour as checked from given water rate of 21.6 lbs. per hp. hour, with varying rates of combustion: (6, 7 and 8 lbs. water per lb. coal.)			
	4-6-2:			
	2,600 hp. × 21.6 ÷ 6..9,360			
	2,600 hp. × 21.6 ÷ 7..8,000			
	2,600 hp. × 21.6 ÷ 8..7,000			
	Average	8,120	.....	.....
	B. & O. 2-10-2:			
	3,000 hp. × 21.6 ÷ 6. 10,800			
	3,000 hp. × 21.6 ÷ 7. 9,255			
	3,000 hp. × 21.6 ÷ 8. 8,100			
	Average	.....	9,385	.....
	Erie 2-10-2:			
	3,200 hp. × 21.6 ÷ 6. 11,500			
	3,200 hp. × 21.6 ÷ 7. 9,850			
	3,200 hp. × 21.6 ÷ 8. 8,650			
	Average	.....	.....	10,000
18	Coal per sq. ft. of grate (Item 16, Item 9).........	100	92	975

In order to get the percentage by which these locomotives fell short of their theoretical expectation, or the power they were intended to produce, by the design adopted, when fired by hand, were worked out by Mr. Pomeroy. The following equations, the terms of which were drawn from the items given in the preceding table, are before us. When worked out they become:

$$1.\quad \text{P. R. R. 4-6-2; } 1 - \frac{5000 \times 100}{7020} = 29 \text{ per cent. less}$$

than the theoretical power, which it is reasonable to expect, with the kind of design used, when the engine was hand fired. The result for the B. & O. engine was,

$$2.\quad \text{B. \& O. 2-10-2; } 1 - \frac{5000 \times 100}{8100} = 38 \text{ per cent.}$$

less for hand firing, and the Erie engine:

$$3.\quad \text{Erie 2-10-2; } 1 - \frac{5000 \times 100}{8640} = 42 \text{ per cent. less}$$

for hand firing.

In obtaining data for the quantity of coal which, on the average, a good fireman can use a No. 3 scoop was taken as an example. This holds about 19½ lbs. At 5,000 lbs. an hour such a shovel or scoop would have to be handled 256 times in the hour, in order to deal with that amount of coal. This means a shovelful of coal would have to be lifted every 14 seconds.

No matter how much coal could or might possibly be burned in the firebox of the engine in an hour, the fireman's limit is 5,000 lbs. The first three equations, given above, show a falling off when hand firing is in vogue, and this decrease brings it below the what it is possible to burn in an engine designed, as these three typical locomotives have been designed.

The P. R. R. engine only developed $100 - 29 = 71$ per cent. That is, the hand firing only got up to 71 per cent. of what was intended by the style of design, and which is possible to get. The B. & O. engine gave $100 - 38 = 62$ per cent. of what might theoretically have been reached, and the Erie engine developed, under hand firing, $100 - 42 = 58$ per cent. only of what it was capable of doing.

So far it is apparent that if the theoretical capacity is correctly stated in the table, and if 5,000 lbs. an hour fairly represents the fireman's limit, then it follows that the handicap in obtaining the full value of the design is the fireman's limited physical endurance or capacity. The fireman does excellent work and is hard at it, but the possibilites of the engine are beyond him, through no fault of his. When this condition is reached the implied responsibility for the non-economical operation of the engine does not rest upon the shoulders of the capable fireman.

By stating the mathematical analysis of the problem in another way, further light is thrown on the subject. If the full amount of coal, as given in the table, had been used, as it theoretically should have been used, three other similar equations may be set down, to show the falling off due to hand firing:

$$4.\quad \text{P. R. R. 4-6-2}\quad \frac{7020 \times 100}{5000} - 1 = 40 \text{ per cent.,}$$

which is the amount of increase above hand firing which the full amount of coal, if used, would have given. This is the greatest percentage in theoretical capacity, which is required to realize the best performance which the design of the engine called for. This engine was intended to burn 7,020 lbs. of coal an hour, and to do this, hand firing must be increased 40 per cent. The other equations are:

$$5.\quad \text{B. \& O. 2-10-2}\quad \frac{8100 \times 100}{5000} - 1 = 62 \text{ per cent.}$$

$$6.\quad \text{Erie 2-10-2}\quad \frac{8640 \times 100}{5000} - 1 = 72 \text{ per cent.}$$

It is quite evident from Mr. Pomeroy's analysis, somewhat amplified here, that under the conditions stated hand firing is not economical, and the very natural conclusion is, therefore reached that if the fireman is up to his limit, the mechanical stoker is the logical and desirable apparatus to bring into use.

The mechanical stoker was not originally developed so much to do better work or to save coal within the limits where fireman and stoker were on a more or less palpable equality. The stoker does its best work where the fireman leaves off, and thus demonstrates that there is no substantial rivalry between the two. Each has its own sphere of action. The stoker, however, shows what is equivalent to a saving when it throws on the fire more coal than the fireman could handle. The "saving" thus effected is not that a less number of pounds of coal is used, which is the general view of what constitutes a "saving." The measure of the stoker's "saving" should be represented in full capacity locomotive performance, when working the machine for "all that it is worth." Hauling more cars, surmounting grades wthout reduction of load, and probably making better time over the road is its record.

If a hand-hammer be lifted by an overhead locomotive crane in a repair shop, the hammer goes up satisfactorily, and as a "lift" the crane may have done admirably, and it may have been all a child could hook onto the crane —the hammer was its limit; but as the crane can lift a locomotive, and yet a hammer was substituted, the work of the crane cannot properly be described as economical, and the extra power put into the crane in order to lift an engine gives a decidedly tangeable and profitable exhibition of what it was designed for, and what it was intended to do. Less than full capacity work looks something like waste, somewhere, and to stop waste is a saving.

Though you may have known clever men who were indolent, you never knew a *great* man who was so.—*The Two Paths.*

AVAILABILITY OF THE INJURED MAN.

In our October issue, on page 323, we made some reference to progress in the art of ameliorating the condition of war victims and industrial cripples. We used as title "The Industrial Sambrowne Belt," to indicate that what had been done by a one-armed soldier could be done, and better done, in the industrial world to-day. In that article we endeavored to emphasize the well nigh marvelous results obtained by the psychological power of suggestion.

When a crippled man is made to believe that the door to useful and productive employment is not closed against him, more than half the battle is won. There is no lack of men with the power to persuade their fellows, but the work of encouraging and educating a physically disabled man may not be accomplished alone by the phrase-maker

Artisan Without Forearm or Hands at Work at the Bench.

or the practised speaker. The power required to carry home conviction and deepen it to abiding faith, must rest on the forceful evidence of the thing done.

Our illustration shows a man, deprived of both hands, yet working as an artizan. He has a metal fixture, made to hold a hammer as the substitute for the right hand, while the left arm is supplied with a suitable device for other work. The man actually does work, and is therefore not helpless or even permanently dependent. The effective work done by a hammer is largely due to the weight of the instrument itself, and in many mechanical operations the specific movement of the arm, still possessed by this crippled man, is all that is required to raise, guide and strike the blow. The hand itself actually performs but a small part of the operation and, as is here shown, it is not essential. The close analysis of action is the vital part for him who seeks to help.

In all nature the adaptability of hand and arm stand out in marked contrast, according to the uses to which they have been habitually put. The human hand, and that of the man-like apes, is fitted to grasp. In the case of the horse, although in the lower Eocene period. he started out with five digits, the desire to grasp was absent, and all else was subordinated as he unconsciously strove to gain in height and speed. To-day we find the horse, with fore-limb similar in structure to our own, yet using it for a wholly different purpose to that which we think best for us. The fore-limb bones of birds are anatomically similar to those of man, and though now employed for flight, are derived from a common plan, and even the paddles of the seal are now, after the lapse of time, but modifications of one original model.

It may not be that we, in a few days, or even years, can emulate the work which nature has required vast ages upon ages to accomplish, but the fact that these marvelous changes, wrought on a single scheme, exist, and can be seen by us, may direct our thoughts to a more clear-cut analysis of the exact functions of that body-implement, which we call a limb. The man represented in our illustration can strike a blow as accurately and as effectively as a being with two hands. There are many kinds of attachments which may be made to replace the arms and legs and the hands and feet.

Our object here is to present to our readers what to many may be unknown, for this analytical examination of man as an animated machine, is not so very old. It is a phase of the awakening sentiment of sympathy which is beginning to stir the hearts of men. This study has revealed possibilities hitherto unknown. Men without feet can climb, and those without hands may shovel coal, or work with hammer or with file.

The contraction of muscle and the movement of a limb, a hand, a foot, may be satisfactorily simulated by a resilient spring, a steel gauntlet, or an iron boot, while yet the intellect of this piece of crippled humanity is unimpaired. Our inventors, our manufacturers, our employers of labor, and our railroad men are keen and quick to adapt means to an end. Thus it may be that great good shall yet grow out of the full realization of what now we faintly see, that the arm or hand is not the man, as the dynamo itself is not the silent force that drives.

THE "EMPIRE STATE"

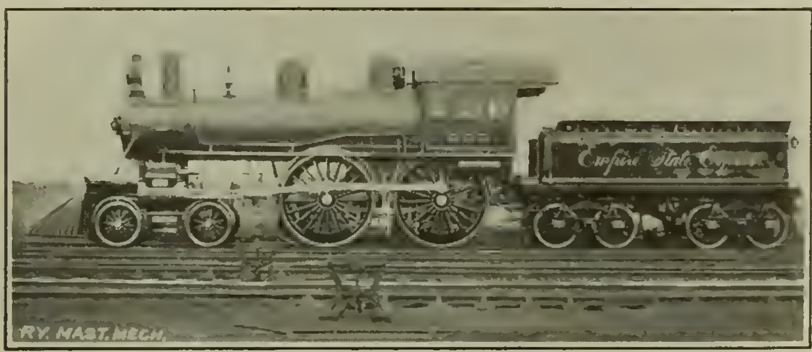
Setting one's watch by the movement of a train on its regular run is rather doubtful, especially if the watch is an accurate time-keeper; but the New York Central can lay claim to reliability in this direction so far as the famous Empire State Express goes.

Here is a train which will celebrate its twenty-fifth birthday next year, and its regularity has become a proverb. The citizen along the line who is in the habit of setting his watch by its arrival at stations never fails to keep his engagements. In the time it has been in operation it has carried almost as many people as live in Greater New York twice over; it has wheeled off more than six and a half million miles, and no fatality has marred this record. Dessin J. Cassin, its engineer for sixteen years, was awarded the Harriman bronze medal last year, which recognized an unblemished record for safety.

At the outset, the "Empire State" was a small train. It gradually increased its weight, until now it has double its original length. The original locomotive, known as "999," would fail to haul it at schedule speed. A heavy locomotive of the Pacific type does the work now with ease, and will continue to maintain the reputation of the train on its daily runs between New York and Buffalo. The New York Central is open to congratulations not only for this excellent service, but for maintaining a high standard of performance in the way of general train service and safety.

Silver weddings come after 25 years of married life, and the quarter-century "jubilee" has come in the same time to the Empire State Express on the N. Y. C. This train began to run in 1890-1 and has given what theatrical managers would call a "continuous performance" ever since. A picture of this train going at full speed was well known in early days; it was photographed by A. P. Yates of Syracuse, and the exposure of the photographic plate was only the one-thousandth of a second. The picture is now practically impossible to get.

The train originally weighed 230 tons and was hauled by the famous engine known as "No. 999," weighing



Old 999 of the Empire State Express.

204,000 lbs., exhibited at the Chicago World's Fair. It is now a train of 780 tons, hauled by an example of modern motive power, the Pacific Type or 4-6-2 engine, weighing 422,000 lbs.

The train was made up, in at first and in subsequent years, of four cars and was hauled by a 4-4-0 engine. To-day a 4-6-2 engine pulls the train made up of seven or eight coaches, and although the schedule remains the same, being about 50 m. p. h., it reaches New York invariably on time. Our illustration shows Engine 999 as built from designs by Robert Buchanan, then S. M. P. of the "Central," and it was through the instrumentality of the former general passenger agent of the road, Geo. H. Daniels, that this engine and the train attained world-wide celebrity.

The speed of the Empire State Express often exceeds that shown on the time table. It was in one of these bursts of speed that the picture we speak of was taken. The train was rushing forward at about 90 miles an hour while the special camera used to record its flight, winked once. Notwithstanding the extremely high speed of the train the eye of the camera saw it moving only the width of two postage stamps placed side by side. Rapid as was its motion, the camera was faster, for brief indeed was its time to look, yet the camera recorded every detail.

Swift sunlight caught the tossing plume of steam, it rested on the moving polished steel, and held the engine bell fixed on its upward swing. It streamed through between the spokes of the spinning, racing driving wheels. While the train advanced less than two inches on the rails it was as if a gossamer thread of golden sunlight one hundred and eighty-six miles long, had been reeled into the camera through the open crystal lens, and had written its story on the silver salts of the plate, while the flashing, instant-moving shutter, snapped shut.

OPERATION OF STATE-OWNED RAILWAYS

The State-owned Santo Amaro Railway, comprising altogether 59 miles of track, connects the towns of Santo Amaro and Bom Jardim, and the principal freight carried by it are sugar and its products. The road showed a profit of $46,176 in 1914, its receipts having been $142,028 and its expenditures $95,852, according to recent Commerce Reports. The other State-owned Nazareth Railway had a profit last year of $41,354, which was 52 per cent less than in 1913, owing to washouts caused by floods.

THE INTRODUCTION OF THE SILENT POWER

The time will come when that wonder of inventions—steam—will have had its day; when the silent power, called electricity, will take its place, and coming generations will find examples of our modern giant, the locomotive, resting peacefully in museums alongside the old-fashioned stage coach and the once popular horse car.

Black smoke and dust and noise, which have been the bane of the journey-taker and householder as well, will be but memories only and will be mentioned as those flagrant nuisances of the present century.

Steam has served its purpose well. It has stood for progress and the civilization of the world. It represents the result of human ingenuity in its highest degree. But times and customs change; the human intellect drifts into unknown fields of conquest and searches for something new, which it is forever discovering. A generation or so ago it was little presumed to what level of commercial value the silent power would climb, and, like the telephone, in its infancy it never once gave promise of its later fame; but its introduction has finally brought about one of the greatest eras in human progress. Riotous rivers in some sections will be yoked to powerful turbines and immense electrical generators, and the silent power thus harnessed will be transmitted long distances for railway and other service. Unused streams will be turned to this account in other sections, too, and we look not in vain for the time when the third rail and the overhead trolley will be condemned and abandoned for the storage battery (yet in its infancy), which in turn will

A Station Where the "Silent Power" is Born.

take the place of a tank full of coal, while an electric charging station will be substituted for the coal bin and operated by the flow of water hundreds of miles away.

The mysterious silent power (an appropriate pseudonyum for electricity, like the improvised appellation applied to the Swiss mountain snow—"the white coal of the Alps") is coming into vogue. Future generations will glide along the rails from Maine to California at speed beyond present-day comprehension, and with the smoothness of a becalmed sea. As it will be in the common use of flying machines later on, people will be born and brought up to the application of electricity everywhere, and the once grand old iron horse will have been forgotten. The Chicago, Milwaukee & St. Paul seems to be among the foremost in a very general adoption of the silent power, and the article in this issue relating to this may be of special interest to our readers.

Progress in Electrification on the C., M. & St. P.

Construction work on the electrification of the western lines of the Chicago, Milwaukee & St. Paul Railway has been prosecuted most actively since the initial order for equipment was placed in September of 1914. In view of the magnitude of this project, the progress made so far has been good.

The overhead construction, which includes 650 miles of single track, has been completed for a distance of more than 200 miles. The 100,000-volt transmission line being erected by the railway company to parallel the electrified tracks has been completed for an equal distance, and tie-in lines from the 100,000-volt system of the Montana Power Company are ready for service. The trackage now ready for train operation includes extensive yards and sidings at Three Forks, Deer Lodge and Piedmont, and passing tracks at other points. The rail-bonding crews have followed the overhead construction gangs in completing the ground circuits.

and electrical equipment is being rapidly installed. Construction crews are proceeding with the erection of the remaining substations between Deer Lodge, Mont., and Avery, Idaho.

Each of the motor-generator sets consists of a 60-cycle, 3-phase, 2,300-volt synchronous motor, direct connected to two 1,500-volt direct-current generators. The generators are connected permanently in series to supply 3,000 volts to the trolley. Each set is also provided with an exciter at each end, one providing excitation for the revolving field of the motor and the other supplying the separately excited fields of the D. C. machines.

These sets are in general similar to the five 1,000-kw., 2,400-volt units in operation on the Butte, Anaconda & Pacific Railway, except as regards voltage and capacity. One new feature, however, has been added. It consists of a longitudinal ventilation of the core and field coils. The use of this method of cooling has effected a considerable reduction in the floor space required per kilowatt.

General View of Two Chicago, Milwaukee & St. Paul Electric Locomotives Used as One Unit.

Our illustrations show the general appearance of the new type of trolley construction and transmission lines. It will be seen that wooden poles are used throughout, both for cross-span and bracket construction. The twin 4/0 trolley wires are suspended, individually and separately, from the same steel catenary, and the hangers of one trolley wire are placed at points opposite the middle span on the other wire. In the switching yards only one trolley wire is used.

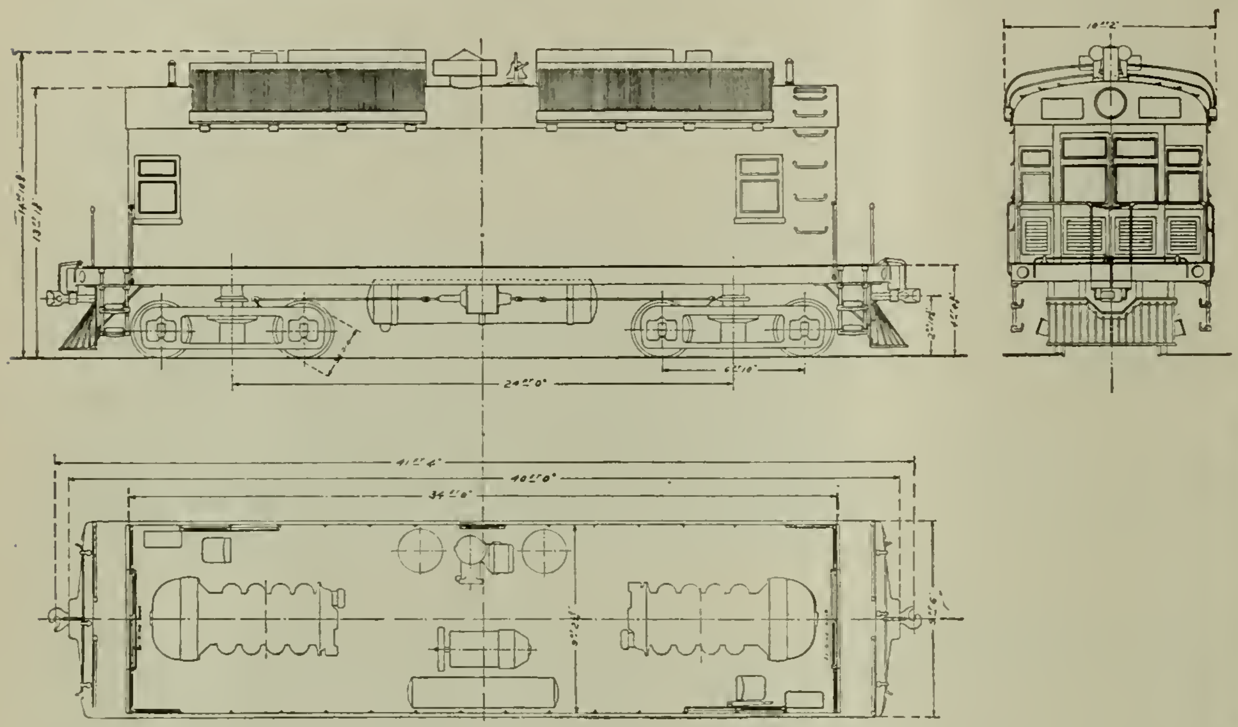
Seven substations, designed to supply power to the first half of the 440 miles of road, have been completed

The D. C. generators are equipped with commutating poles and compensated pole-face windings to insure sparkless commutation under heavy overloads. This overload capacity is 150 per cent. normal load for two hours and 300 per cent. normal load for periods of five minutes. This will provide ample margin for starting a train of maximum tonnage on the most difficult grades.

It is interesting to note in connection with these substations that the motor-generator sets are designed to

operate inverted in case the regenerated power exceeds that required by other trains operating near by. For this reason there is no necessity for water boxes or other energy-consuming devices, since the excess energy is transmitted to the 100,000-volt system.

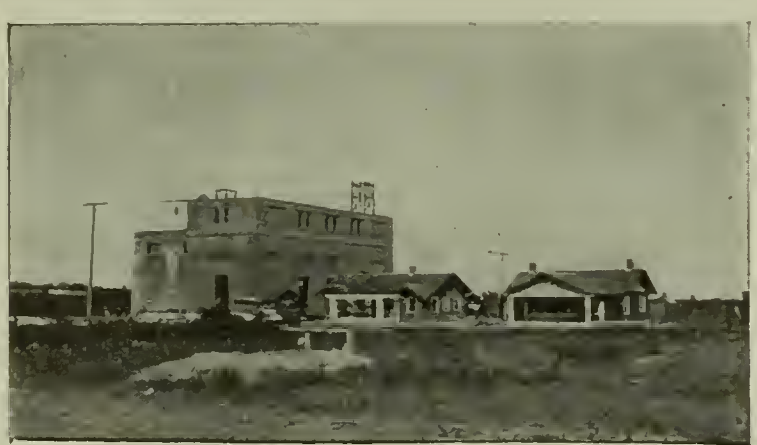
The main direct-current switchboard in each station



Outline Drawing of Electric Locomotive, C., M. & St. P.

is of special interest, since it represents the latest practice in high-voltage direct-current switching apparatus. A panel is provided for each set, and two panels are provided for feeders in each direction. The circuit breakers and switches are mounted on separate panels located above and a short distance back of the main panels. The control handles for operating the breakers and switches are on the main panels, and are connected to the circuit-breaker panels through insulated wooden rods.

In addition to these special panels, switchboards are furnished for the synchronous motors and auxiliary cir-



Sub-Station, Electrification Scheme.

cuits. Oil switches and other standard 100,000-volt equipment are also being installed for the high-tension circuits.

The transformers used are examples of recent design. There are a total of thirty-two of these, which are for stepping down the power supply from the 100,000-volt transmission line to 2,300 volts, as required for the synchronous motor-generator sets.

The transformers are all of the 3-phase core type, with a ratio of voltages of 102,000 to 2,300. For regulating purposes, taps are provided for 97,200 volts and 94,200 volts. Taps are also brought out on the secondary windings to give 1,150 volts, or half voltage, for starting the motor-generator sets. The transformers are oil cooled and the tanks are of the tubular type, the main body consisting of steel plate with tubes welded to the side of the tank at top and bottom. An air dryer and breather is attached to the tank, so that all interchange of air between the interior of the tank and the outside must take place through this channel. The dryer is provided with chambers containing a medium for moisture re-

End View of C., M. & St. P. Electric Locomotive.

moval. In addition to the main transformed equipment, each substation will be furnished with a standard 10-KW. 3-phase transformer, stepping down from 2,300 volts to 110 volts for lighting and auxiliary power circuits.

For operating the railway signal circuits a standard 25-KW. single-phase transformer is being installed in each substation, stepping up from 2,300 to 4,400 volts. A portable oil-drying outfit will be used for removing moisture from the transformer oil. This outfit consists of a motor-driven pump which forces the oil through an especially designed filter, and an electric drying oven for drying the filter paper is provided. A portable transformer-dryer and an oil testing set will also be supplied.

For housing the families of the substation operators a four-room and five-room bungalow is being constructed at each station, and these will be furnished with light and power from the low-voltage auxiliary circuits.

Work on the construction of the forty-two 282-ton locomotives for this road is progressing rapidly. The first complete locomotive was placed on the test tracks early in September, and shipment was made as scheduled. This locomotive has been taken in charge by the railway company at Chicago, and is now being exhibited at various points on the Chicago, Milwaukee and St. Paul system, under the direction of Mr. C. A. Goodnow, assistant to the president. A complete set of tests indicate that the locomotive will easily exceed the expectations of the designers. The actual weight of the completed freight locomotives are as follows: Total, 564,000 lbs.; weight on drivers, 448,000 lbs.; weight per driving axle, 56,000 lbs.; weight per guilding axle, 29,000 lbs.

Twelve of the locomotives are geared for passenger service and the remaining thirty are geared for freight service. Both freight and passenger types are equipped for regenerative braking, this apparatus being under control of the engineer. All of the passenger locomotives and several of the freight locomotives will be equipped with oil-fired steam boilers for heating the passenger trains. This equipment will include ample storage tanks for oil and water. Pantagraph collector apparatus is used on each of the locomotives.

American Designed Freight Cars for Russia

The car equipment orders recently placed in this country by the Russian Imperial Government include a lot of 5,000 steel general service gondola cars which are now being built at the McKees Rocks plant of the Pressed Steel Car Company, and an example of this order is represented in our illustrations. This car was designed by the builders, and it will be seen from the illustrations that aside from the couplings and buffers, which are the Russian standard, it is very similar to one of our own most popular types. The rated carrying capacity is 50 metric tons, or about 110,000 lbs., and the light weight about 46,000 lbs. One of the requirements of the specifications was that the car must stand a test load of 75 metric tons uniformly distributed without permanent set, and the completed car was so tested with results which were entirely satisfactory.

The bodies are 40 ft. long by 9 ft. 6¾ ins. wide by 4 ft. 4 ins. high inside, and have doors on both sides throughout the length, making them about 99 per cent. self-clearing when loaded with coal or similar material. The doors are operated by the Pressed Steel Car Company's creeping shaft device and rest directly on the shafts when in the closed position. With this device the chains, which wind on drums, are only employed for lifting the doors and to hold the shaft in place under them when in the closed position, as stops are provided to engage both sides of the doors when they are dropped, thus eliminating the shock which would otherwise have to be absorbed in the chains when load is dumped. The ends are made of 2¼ ins. planks, reinforced all around with 2½ x 2½ x ¼ ins. angles bolted to planks and are secured with links at the end sill in such a manner that they can be dropped into the car when not required, thus making the car more suitable for the transportation of long materials.

The center sill construction is continuous from end sill to end sill, consisting of two 5/16 in. bent plates riveted to a 4 in. rolled Tee at the top and each reinforced at the bottom with a 3½ x 3½ ins. angle. Malleable iron center braces are provided at the bolsters and pressed steel braces at the cross ties. The end sills are ⅜ in. pressed steel, reinforced with pressed channels extending between short side sills and center sills and connected to them, and are braced from points at the rear of the buffers with pressed channel-shaped braces in such a manner that the major portion of the buffing shock will be transmitted through these braces into the center sills. The bolsters and cross ties are pressed diaphragms reinforced with plates and agles.

The sides are made of ¼ in. steel plates in three lengths, supported by seven pressed steel side stakes located at bolsters and cross ties, and are reinforced at the top with 4 ins. rolled steel bulb-angles extending full length. Near the bottom the side sheets are sloped in at an angle of about 60 degs. and have a flange turned out which rests on the end sills, bolsters and cross ties and is riveted to them. The bottom of this flange lines up with the bottom of the cover plates on the bolsters and cross ties, thus permitting of the doors to be closed up tightly against these parts.

The drop doors, of which there are sixteen, eight on each side of the center, are made of ¼ in. steel, flanged on all sides and supported on three forged hinge-straps which are pin-connected to malleable iron hinge-butts riveted to the center sills. Besides the hinge straps, there are two stiffeners of 2½ x 2½ x 3/16 in. angle extending crosswise of car and one 3 ins. rolled Z-bar located near the outside and extending lengthwise of the car, are provided on each door. The door stops are placed so as to secure a discharge opening about 2 ft. deep between the trucks, but due to the large wheels used the door openings over the trucks are somewhat less.

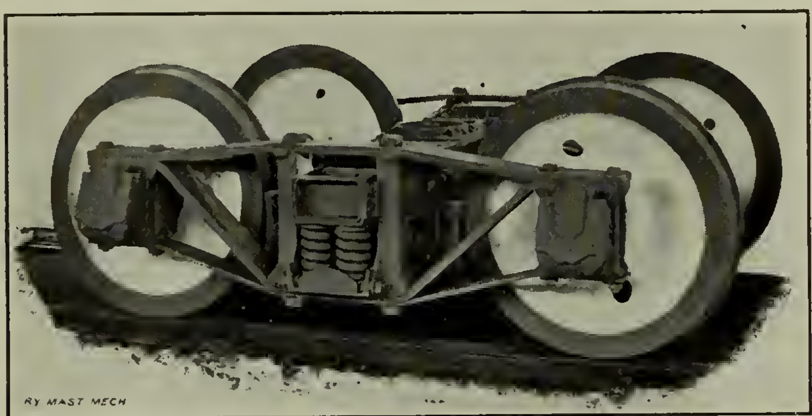
The Russian type of Westinghouse air brake equipment with 10 ins. cylinder is being applied, and while it differs quite a little in detail from the Westinghouse freight car equipment used in this country, it is made on much the same general lines. The foundation brake rigging is consistent with standard practice in this country, but involves the use of a tension spring to insure proper release of the brake shoes.

The couplings, which are of the hook and link type, and the buffers are the Russian standard, except that coil springs have been substituted instead of the Volute springs used by them in the past. Each of the couplings is made up of nine drop forgings of special heat treated steel having an elastic limit of 56,000 lbs. per sq. in. for some parts and 44,000 lbs. per sq. in. for others. A test load of thirty tons is required to be applied to the finished coupling which they must stand without permanent set. The buffer stems are required to be forged without a weld, and the manufacture of this item, as well as that of the couplings, involves some very interesting forging operations.

The trucks are of the arch bar type, having 6 ft. 3 ins.

New American-Designed Steel Dump Car for the Russian Imperial Government.

wheel base and follow the lines of the standard M. C. B. construction, though somewhat larger due to the use of 41 5/16 ins. diameter wheels and to adapt them to the Russian standard gauge, which is 60 ins. They are being equipped with pressed steel bath-tub type bolsters, having cast steel center plates of M. C. B. contour and adjustable malleable iron side bearings. Other equipment includes M. C. B. malleable iron journal boxes, drop forged wedges, class "D" springs, and cast iron brake shoes. The brake beams are similar to the M. C. B. No. 2, except modified to suit the gauge and are suspended from brackets cast integral with column posts by U-shaped hangers. The arch bars are 6 ins. by 1¼ ins. O. H. S. and the tie bars 5 in. by ⅝ in. These are secured to cast steel column posts with 1¾ in. bolts and to journal boxes with 1¼ in. bolts. The spring planks are 13 ins., 32 lbs. rolled channels, and are bolted to column posts with 1 in.



Russian Car Truck, Built on M. C. B. Pattern.

bolts. Into these at each end is fitted a malleable iron spring seat having flanges at both ends to strengthen the truck at this point. The wheels are rolled steel with flange and tread similar to the Russian standard but differing only slightly from the M. C. B. These are being manufactured to their specification and weigh nearly 1200 lbs. each. The axles are of steel, having journals, collars and dust guard fits the same as the standard M. C. B. axle for 100,000 lbs. capacity cars, and except for the increase in length over the M. C. B. axle necessary to suit the gauge, the most important difference is in the wheel fit which differs from the M. C. B. in that in place of the collar back of the wheel hub the diameter of the

End View of Dump Car for Russia.

axle is reduced to less than the diameter of the wheel fit at this point, in fact this reduction in diameter begins about ¼ in. under the wheel hub.

The completed car stands 8 ft. 11 ins. from rail to top of sides, is 44 ft. 4⅛ ins. long over the buffers and presents a substantial and clean-cut appearance. Every detail seems to have been given careful attention, and this car should give a very creditable account of itself in service. Aside from the cars themselves, their delivery is interesting in that they practically circle the earth before they reach their final destination. The cars are knocked down, packed and shipped to New York, where they are loaded into boats and start on their long voyage to Vladivostok via Panama Canal. At Vladivostok they will be assembled and make the rest of the journey on their own wheels.

The trucks are shipped built-up complete, and the underframes are also assembled complete with the end sills, cross ties, bolsters, short side sills, door stops and braces riveted and the doors, shafts, chains, and other parts of the door operating device in position. The sides are also riveted up complete, and two sides are secured together to form one package. The end gates are packed in a similar manner and the smaller parts are packed into boxes, each box in most cases containing materials in complete sets for five cars.

WHAT THE GREAT NORTHERN DID

No road except one which has been kept up to a high grade of maintenance could accomplish what the Great Northern Railway Co. did in the year which ended June 30 last.

Owing to a low average for the grain crops along the line, reduced rates, a general beusiness depression due to the European war or other causes, there was the tremendous decrease of $9,692,079 in gross earnings.

By reducing operating expenses by the surprising sum of $10,941,499, there resulted an increase in net earnings for the year of $1,249,419. This is a marvelous showing. The total gross earnings for the year were $67,162,857; total operating expenses, $36,828,274, and the net income $20,618,270.

THE ITALIAN METHOD

The latest obtainable information concerning the Italian government's operation of its State railroads covers the year 1912. Gross revenues amounted to $116,568,348 and the operating expenses exhausted $97,871,890. The net profit, as it appears, was only $18,696,458. These railways are capitalized at the modest sum of $158,185 per mile. This capitalization and the tremendous cost of operation are charged to political influence. Deducting interest charges, which, in round figures, amount to $53,000,000 for the year, and taxes lost, by reason of government ownership, which are estimated in the neighborhood of $10,000,000, there was a direct loss altogether of nearly $45,000,000! In Italy, out of every 100,000,000 passengers carried, 54 are killed. In the United States the average is less than two out of a like number.

There seems to be but one trend to affairs when governments undertake the ownership and management of railroads.

The gross earnings of Wells Fargo Co. for the year ended June 30 last amounted to $38,544,786, an increase of $7,191,557. Expenses increased $3,128,587, and the net earnings, after deducting all charges, were $2,338,677, equivalent to 9.75 per cent. on the $23,967,400 capital stock, compared with 9.78 per cent. for the previous year. Considering parcel-post competition, business depression and the European war, this is not a bad showing, to say the least. This company is operated over 66,537 miles of railroad, maintains 7,271 agencies, employs 22,269 men, and had 5,290 stockholders when the books were closed on July 7th last.

That Important Necessity—Varnish

Varnish, as we know, varies in quality by reason of the method and material employed in its preparation. An expert user of varnish knows how to apply it and is able to determine whether it is of good quality or not. He may not, however, be familiar with the method of its manufacture nor with all the materials which go into its preparation.

This all important compound, which occupies such a necessary place among railroad supplies, is worthy of some consideration, to the end that the buyer as well as the user of it may know something about what is employed in its manufacture, how it is manufactured, and how important a part the gum or resins which were laid by in the soil ages ago play in its make-up.

Copal gum, which is the base of all good varnish, is composed of carbon 79.89 per cent., hydrogen 9.00 per cent. and oxygen 11.11 per cent., and the fossil gum, so called, which makes the best varnish, originally exuded from certain coniferous or better known as cone bearing trees. It is found in both eastern and western Africa and elsewhere in the old world, being dug up by the natives to-day along and back of the ancient sea beaches, now far inland, and is transported to the coast for shipment to the various markets. This gum is the only evidence now of vast forests which flourished in all their luxuriance thousands of years ago; just how many, is left to the determination of geologists, who fathom mysteries of this sort as best they can by careful comparative calculations. These deposits, however, once so plentiful, are now practically exhausted in some sections. The Zanzibar gum, or copal of commerce, from which the most durable and finest varnishes have always been made, occurs in dull flat pieces, from the size of a bean to that of the hand, and in shapes like nuts, globules or drops, just as it ran from the tree. It is covered with sand and earth, but after washing has a decided transparency, with elevations on the surface resembling pin heads or goose-flesh; has a glassy fracture, is about as hard as amber, and is susceptible of being ground and polished. It sometimes bears the name of Salem or Bombay copal. Many samples of this gum, when polished, bring to light flies, spiders and other insects which were imprisoned there in the midst of their pursuits many ages ago, when the gum in a viscid state exuded from the trees. "The fly in the amber" which the poet has incidentally mentioned is founded, therefore, upon fact, and does not represent the idea of a dreamer, who often pictures in his brain scenes which are not only improbable, but absolutely impossible. This gum furnishes the hardness, the elasticity, the polish and the clearness which varnish requires, and resembles amber in many particulars. It is insoluble in either alcohol, linseed oil or turpentine, but becomes soluble when the solvents are heated, and upon the proper heating of both the copal and the alcohol, oil or turpentine when the varnish is prepared depends the quality of the varnish which is produced.

To-day, by reason of the scarcity of better grades of gum, varnish makers depend upon other fields for their supply, and the Kauri gum, found in New Zealand, is the most available. It is a product of the Kauri pine, but lacks the hardness and other qualities of Zanzibar copal because of its more recent growth. Necessity frequently compels us to resort to many methods out of the ordinary, but the ingenuity of the present day manufacturer is able to overcome difficulties which once seemed insurmountable, and results are obtained to satisfy the demand of the most critical and exacting. Railroad coaches and locomotives now in service are not only fine examples of the painter's skill, but represent the highest grade of efficiency in the manufacture of such important products as paint and varnish. The qualities necessary to make varnish acceptable, especially in railroad work, are color, consistency, drying properties, brilliancy and resistance. These are obtained by a careful selection of materials, a correct adjustment of proportions and, finally, a skillful treatment of all the parts employed in the mixture. The gum, therefore, carefully selected, is ground and melted to a liquid, and thereafter, under great heat, is boiled with linseed oil and later thinned by the application of turpentine. The extreme heat necessary is gauged to a nicety, for upon this depends satisfactory results. The linseed oil aids in imparting elasticity, durability and drying properties, while turpentine thins the mixture to the needed consistency. Less oil in the preparation furnishes a rubbing varnish, which is used to create a substantial foundation for the finishing varnish which is finally applied. The experienced varnish maker, familiar with the minutest details, which are so important, is able to produce a varnish to meet the most exacting requirements.

Like friends and wine, varnish improves with age, and is one of the most important items to be found in an inventory of a railroad store room. Even so, there is a case on record where a clever varnish salesman disposed of a large quantity of his wares to an unsophisticated buyer by exhibiting a few samples of Vermont maple syrup. It was purely a matter of taste, as it were.

TELEPHONE DISPATCHING ON B. & O. S.-W.

Telephone train dispatching has been adopted on the Ohio division of the Baltimore & Ohio Southwestern Railroad, on the main line between Cincinnati and Parkersburg. There are about 1,000 miles of this company's lines over which trains are dispatched by telephone. The telephone system is in use in the southwestern district on the lines from Cincinnati to Seymour, Ind., and from Seymour to Louisville.

On the eastern lines the telephone is used from Cumberland to Brunswick, Johnstown to Rockwood, Connellsville to Fairmont, Fairmont to Clarksburg, Grafton to Parkersburg and Wheeling, Wheeling to Pittsburgh and Newark and also on the Staten Island Railway. Even where trains are operated under the manual or other block signal systems the telephone is used to expedite movements and afford additional safety.

The Baltimore & Ohio early recognized the advantage of the telephone as an additional means of securing safety in train dispatching and, following its incorporation in the book of rules governing train handling, investigations were made by foreign railroad officials from Russia and France.

As to the railroads and the duty of the Government to relieve them from the present partial paralysis of their money-making power through unjust rate regulation, says *The Bach Review*, it must be remembered that the present activity in business and the real basis thus far for continued increase is due to the war situation. No business revival heretofore has taken place in this country, except what was brought about through the large purchases of railroads supplying the lack of demand which heretofore has always existed when the railroads were out of the market.

Personal Items for Railroad Men

W. L. Kinsell has been appointed assistant shop superintendent of the New York, New Haven & Hartford R. R. at Readville, Mass.

Walter Shelton has been appointed road foreman of engines on the Chesapeake & Ohio Ry., at Silver Grove, Ky., succeeding David Evans, promoted.

J. J. Dowling, recently appointed superintendent of the Kalispell divison of the Great Northern Railway, with headquarters at Whitefish, Mont., succeeds John Sesser.

J. A. Cochrane, recently appointed superintendent of safety of the Great Northern Railway, with headquarters at St. Paul, Minn., succeeds there J. J. Dowling, transferred.

John Sesser, recently appointed superintendent on the Superior & Mesabi divisions of the Great Northern Railway, with headquarters at Superior, succeeds G. E. Votaw, resigned.

R. A. Billingham, master mechanic of the Tennessee Central R. R., at Nashville, Tenn., has been appointed mechanical superintendent, and the office of master mechanic has been abolished.

J. W. Baum, general foreman of the Lake Erie, Franklin & Clarion R. R., at Clarion, Pa., has been appointed master mechanic, a new position, and the position of general foreman has been abolished.

R. M. Kinkaid, valuation engineer of maintenance of equipment of the Chicago & Eastern Illinois R. R., has been appointed master mechanic of the Illinois and St. Louis divisions, with office at Villa Grove, Ill., vice F. Studer, resigned.

George A. Blackmore has recently been appointed by the Union Switch and Signal Company general sales manager in charge of the activities of the New York, Montreal and Atlanta offices, with headquarters at New York. Resident Managers A. Dean, of New York; T. H. Patenall, of Montreal; and Sales Engineer Brastow, of Atlanta, will report to him. He will eventually be located in Swissvale in charge of sales, construction and commercial engineering.

A. J. Gayfer, recently appointed divisional engineer of maintenance of way of the Lake Superior district of the Canadian Northern Railway, joined the Canadian Northern engineering staff in 1898 and was engaged in various surveys over that line between Winnipeg and Ft. Francis, and in 1899 was made office assistant to the divisional engineer of construction on the same work. In 1902 he was made assistant engineer on the Grand Trunk Pacific, having charge of construction work. In 1911 he returned to the Canadian Northern, working on the main line east of Port Arthur and in 1912 he was appointed divisional engineer on construction in the Port Arthur district, which he held until the announcement of his recent appointment.

E. Lambert, recently appointed trainmaster of the Syracuse Division of the New York Central at Syracuse, entered railroad service in 1891 as office boy to the superintendent of the Lansing division of the Lake Shore and Michigan Southern at Hillsdale, Michigan, and later served as relief agent and operator on that division and as night operator at Ft. Wayne. In 1893 he was appointed clerk in the train master's office in Chicago and later served as car distributor and train dispatcher. In 1899 he resigned and became private secretary to the general manager of the Chihuahua and Pacific Railroad, a new line just built, and remained there until the road stopped construction work. In 1902 he entered the service of the New York Central at Buffalo as car distributor and in 1908 was made chief clerk in the superintendent's office at Syracuse. In 1912 he was appointed to the newly created position of assistant trainmaster, which he held until his recent appointment as trainmaster.

Seventeenth Annual Convention of the Chief Interchange Inspectors' and Car Foremen's Association of America—Richmond, Va., September 14 to 16, 1915.

H. J. White, recently appointed supervisor of car work of the Eastern lines of the Canadian Northern railway, entered railroad service in 1893 as car repairer and joint car inspector between the Boston & Maine and the Canadian Pacific railways at Newport, Vermont, and in 1894 was transferred to St. Polycarpe Junction as joint car inspector between the Canadian Pacific and Canada Atlantic now part of the Grand Trunk. In 1900 he was made car inspector for the Canadian Pacific at Parkdale and later that year was transferred to the Union Yards. Toronto. In 1903 he was made leading hand carpenter of the Canadian Pacific car shops at Outremont. In 1906 he was made car foreman and wrecking foreman at North Bay and was later transferred to the West Toronto shops as general foreman. In 1913 he was appointed

general foreman of the car department of the Quebec Grand division of the Canadian Northern and held that position until his recent appointment as supervisor of car work.

Henry U. Mudge, who resigned last week as chief executive officer of the Chicago, Rock Island & Pacific Ry., has been elected president of the Denver & Rio Grande R. R., succeeding Arthur Coppell, of the Banking firm of Maitland, Coppell & Co., who was elected temporary president last week. Mr. Mudge was born June 9, 1856, at Minden, Mich. He received a common school education, and entered railway service in 1872 as water boy on track with the Atchison, Topeka & Santa Fe Ry. He learned telegraphy, and for two years worked as an operator. This experience was followed by a year as brakeman and baggageman, seven years as conductor of freight, passenger and work trains, and one year as train dispatcher. During the next five years he served consecutively as roadmaster, trainmaster and assistant superintendent. On July 1, 1889, Mr. Mudge was made superintendent of the Rio Grande division of the Santa Fe. He served in this capacity until January, 1893, and then for five months was superintendent of the Western division of the same road. He was then promoted to general superintendent of the Western Grand division. From June 10, 1894, to February 1, 1896, he was general superintendent of the Eastern Grand division, and from then until January 1, 1900, general superintendent of the Atchison, Topeka & Santa Fe Ry., as reorganized. He was made general manager January 1, 1900, which position he held until May 1, 1905, when he resigned from the Santa Fe to become second vice-president of the Chicago, Rock Island & Pacific Ry. He was elected president of the company December 1, 1909. When the road was thrown into receivership last May, Mr. Mudge was made joint receiver with Jacob M. Dickinson. He later resigned as receiver, but continued to act as chief executive officer for the receiver.

OBITUARY

William Frederick Allen, known among railroad men all over the world, and who introduced the method of using what is known as standard time on the railroads of the United States and Canada and other countries, died on November 9 at his home at 180 Scotland Road, South Orange, N. J., in his seventieth year.

Mr. Allen was a member of the Railway and Lawyers' Clubs of this city; he was the founder and for many years the president of the South Orange Field Club, and was a member of the Essex County and South Orange Republican Clubs. In 1871 he married Miss Caroline Perry, who, with four sons, survives him.

Mr. Allen first became connected with *The Official Railway Guide* as assistant editor, becoming editor and manager six months later. The National Railway Publication Company brings out the *Guide* each month. In 1910 Mr. Allen became vice-president of the National Company, of which he became president in 1914.

In 1875 he assisted at the founding of the American Railway Association, of which he became general secretary, holding office until his death. In 1881 the association authorized him to work out and report upon the present standard time system as applicable for railroad use, and he successfully completed the task after about two years work and by combining more than fifty separate systems he produced the final result.

Mr. Allen was a member of the American Society of Civil Engineers, the Geographical Societies of Vienna and Lima, Peru, the American Geographical Society, the National Geographical Society, the American Meteorological Society, the American Academy of Political and Social Science and the American Statistical Society. Princeton University conferred on him the honorary degree of Master of Science in 1906, and in the same year the Belgian government made him a Chevalier of the Order of Leopold, in recognition of his services at the International Railway Congress.

Mr. Allen was born in Bordentown, N. J., and was a son of the late Colonel Joseph Warner Allen and Sarah Norcroff Allen, and was descended from an old Colonial family, the original ancestor of which came to this country in 1681. His father was a noted civil engineer and was active in railroad and water power development in New Jersey and in New York State. After receiving his education at the Protestant Episcopal Academy in Philadelphia, Mr. Allen became a surveyor on the old Camden & Amboy Railroad. In 1868 he was made engineer of the old West Jersey Railroad and in 1870 founded the town of Wenonah, N. J.

James F. De Voy died November 5 in Milwaukee, Wis., after an illness of five months. He was until the date of his death assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul. Mr. De Voy entered railroad service in the mechanical department of the New York Central, and later became connected with the American Locomotive Company. Fifteen years ago he became connected with the Chicago, Milwaukee & St. Paul, rising through various positions and offices in the mechanical department to the one he last held. His positive personality and forceful character marked him out as a man of action, and caused his opinions in matters connected with railway work to be listened to on the floor of railway mechanical conventions. His earnest work on committees was of much value to the Master Mechanics' Association.

Thomas P. Fowler, who was president of the New York, Ontario & Western for twenty-six years, died on October 12 at Warwick, N. Y. He was 64 years old and was born at Newburgh, N. Y. In his earlier days he practiced law in New York City and by reason of his legal talents was called to the presidency of the New York, Ontario & Western. When he resigned the presidency of that road, in 1912, he was a director of the Mutual Life Insurance Co., the Elk Hill Coal & Iron Co., the Lehigh & Hudson River R. R. Co., the Scranton Coal Co., the Mechanics & Metals National Bank, and was president of the Metropolitan Securities Co. He was a member of several clubs and was a forceful, conscientious and successful railroad man. As an executive he was especially noted. The railroad world has lost a prominent figure and one who commanded respect everywhere.

It does not much matter what things are in themselves, but only what they are to us; and that the only real truth of them is their appearance to, or effect upon, us.—*Modern Painters.*

The character of everything is best manifested by Contrast. Rest can only be enjoyed after labor; sound, to be heard clearly, must rise out of silence; light is exhibited by darkness, darkness by light; and so on in all things.—*The Elements of Drawing.*

Practical Suggestions from Railway Shop Men

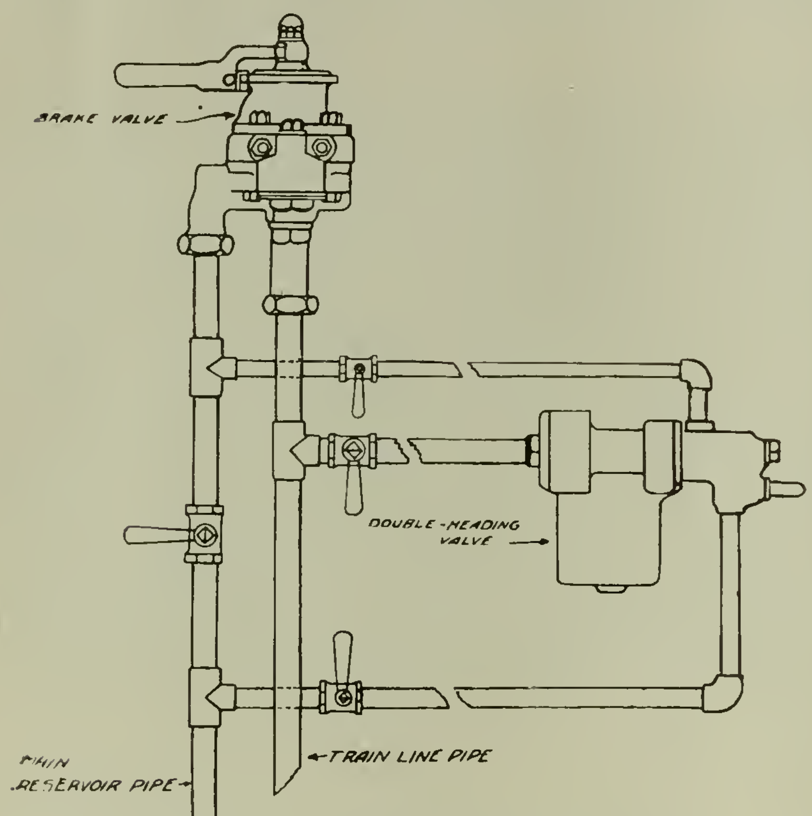
DOUBLE HEADING VALVE

By W. R. Davis, Road Foreman of Engines, Toledo & Ohio Central and the Canesville & Western Railways.

I take great pleasure in sending you a blue print showing the actual size of the double-heading valve and the interior parts, also a blue print of the piping arrangement of the valve. I also give a brief outline of the operation and movement of the parts of this valve, which is handled automatically by increasing or reducing the pressure in the train line.

The train line connects at the left of the valve, and air from the train line passes into the valve against piston 70, forcing this piston to the right. The air feeds over the top of this piston back to chamber 68. In doing this, the piston moves a quarter of an inch, then raises the valve leading from the main reservoir of the second engine and allows air to pass from the main reservoir of the second engine past this valve into the train line, so that the air pump of the second engine assists in maintaining the train line pressure.

When the engineman of the first engine, who is handling



Davis's Arrangement for Double Heading.

the brakes, makes a reduction of train line pressure, also makes a reduction in the chamber ahead of the piston 70, and the pressure in chamber 68 forces the piston to the left, closing the valve between the train line and the main reservoir of the second engine. This piston has a full travel of three-eighths of an inch, by being connected to the main reservoir valve with a slot which allows the piston to move a quarter of an inch before interfering with the main reservoir valve, which raises one-eighth of an inch at its full travel.

The exhaust valve is a little square valve which covers the exhaust port on top of the valve which reduces the air in chamber 68 gradually until it equalizes with the train line. In other words, this has about the same movement as the H triple valve.

There is a valve operated by a spring at chamber 90 at the connection with the main reservoir. This is for the purpose of reducing the pressure from 90 lbs. (if 90 lbs. is main reservoir pressure) to 70 lbs. train line pressure, as this spring has a resistance of 20 lbs. In order to have an additional safeguard, and to be positive that this reduction is actually made, we pipe the valve into the train line and main reservoir at the brake valve, so that the air coming from the main reservoir will pass through the double-heading valve, and if the spring for that purpose fails to reduce the pressure, the air will have to pass through the engineer's brake valve and through the slide valve feed valve, for further protection. The piping diagram shows that we have it so arranged.

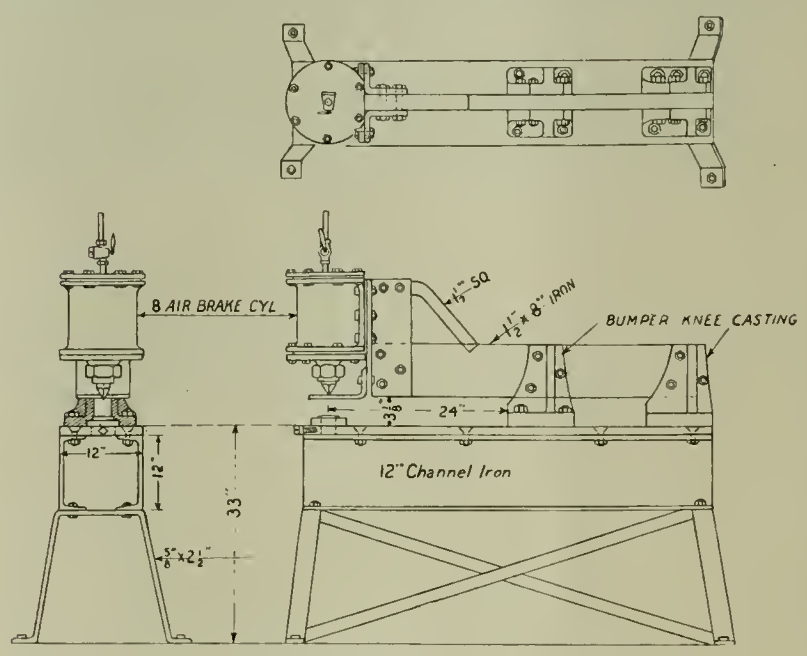
The second engineman places the handle of his brake valve in running position at all times, so that in the event of anything not working properly the second engineman would only have to throw the handle of his brake valve to emergency position to cut out all communication with his engine.

This valve has been tested and has given satisfaction, as we had no difficulty in operating it automatically from the first engine, and it does not matter where the second engine is in the train. The valve operates as well from the rear of the train when using the engine as a pusher, or in the middle of the train, or at its usual position immediately behind the first engine.

AIR-OPERATED PUNCH

By Charles Markel, Gen. Foreman C. & N.-W. Ry.

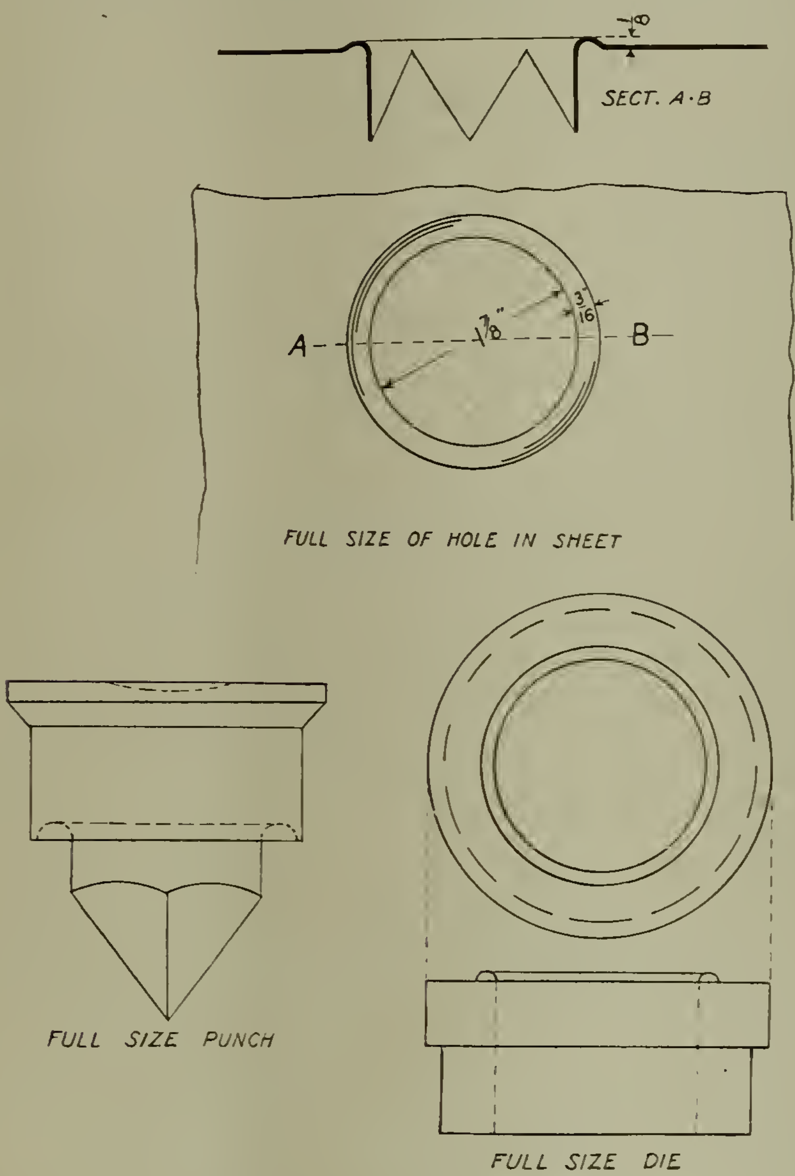
The attached drawing shows a very ingenious and certainly useful home made air-operated punch, that is used to punch holes in the jacket iron that covers all stay bolt holes on back boiler head, throat and side sheets in locomotive boilers. In the machine the main frame that holds the 8 in. air-brake cylinder is made from old bumper beam plate $1\frac{1}{2}$ x 8 ins. and held in place to 12 ins.-channel



Air-Operated Punch and Its Stand.

irons by four bumper beam knee castings. Before this punch was made the tinsmith had to punch these $1\frac{7}{8}$ in. holes with a common boiler sheet punch, which was a slow process, and left no projections on the under side of the punched sheet to hold the sheet-asbestos which all sheets must be provided with, and the old method necessitated strips of iron bolted or riveted to the sheets in order to hold the sheet-asbestos secure to sheets. It

may be seen by reference to the full size drawing of the punch that it is round, squared to point, which point pierces the sheet on entering, and takes very little power when punch is down solid against die. The hole punched is like the full size hole shown by section at A-B, with clean cut edges and four projections ¾ in. long to hold



Details of Punch, Die and Sheets

the sheet-asbestos in place and secure the sheets. The punch and die are so formed as to make ⅛ in. corrugation or bead on the outside of sheet, which makes the sheets stiff and gives a very neat finish. The originator of this machine or punch is Mr. John Charlton, M. M. on the C. & N-W. Ry., at Belle Plaine, Ia.

FIREBOX CLINKERS

An interesting answer by Mr. F. P. Roesch appeared not long ago in the *Locomotive Firemen and Enginemen's Magazine*. It was on the subject of the formation of clinkers in locomotive fireboxes. He said:

"While all admit that they have more or less trouble with the formation of clinkers under certain conditions and when burning certain kinds of coal, yet few are prepared to state exactly what causes the clinker and what can be done to prevent it.

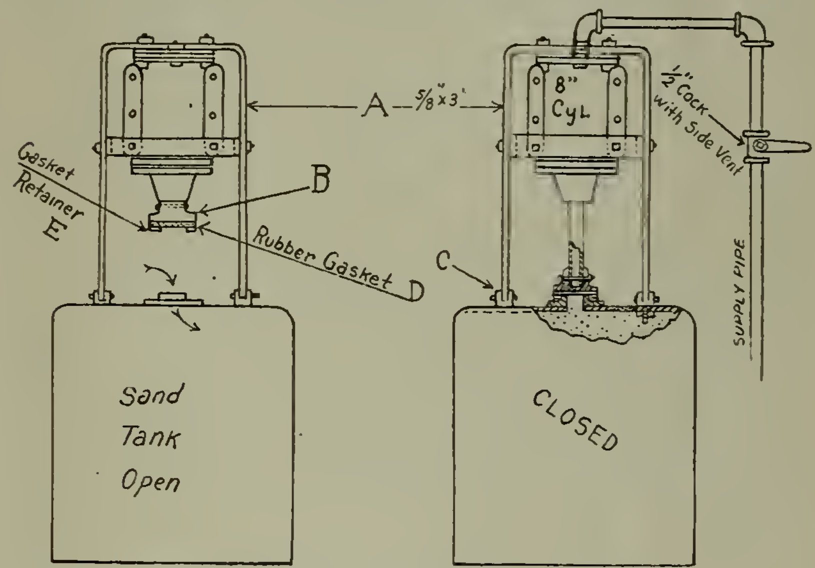
"According to the accepted explanation as to the manner in which clinkers are formed, it has been stated that where coal contains a fairly high per cent. of iron oxide, silica and sulphur, these substances have a tendency to melt, unite and run together in low temperatures, the sulphur having an affinity for the iron oxide, the silica acting as a flux.

"The best methods for the prevention of clinkers are first to refrain from shaking the grates while the fire is moderately light, or avoid the slipping of the engine when the fire is light, as either shaking the grates or slipping the engine under these conditions will cause the fire to be partially turned over, so that some of the fuel which has not as yet reached the highest temperatures will be brought down to the grates, and the inrushing air will cause the formation of a clinker. If the fire can be gradually built up before starting to a point where it is moderately heavy, say 4 or 5 ins., and brought to a bright white heat, and the engine fired very lightly, that is, with but one or two scoops at a time after this, so as to maintin the fire in a bright condition, it will go far, according to the concensus of opinion of those familiar with the subject, towards preventing the formation of clinkers.

"The hook must not be used under any circumstances. If banks form in the fire, coal should be fired around the banks and the banks gradually burned out. The grates should never be shaken violently but simply slightly rocked, enough to insure the passage of air through the fire. The grates should never be shaken even slightly when the engine is working at its hardest. It is also advisable to run with a fairly small nozzle, so that there will be a moderately hard draft on the fire at all times."

DEVICE FOR MAKING SAND TANK AIR TIGHT

Figs. 2 and 3 is a device for closing the filling hole of the tank in the sand house when used for raising sand to the locomotive box by compressed air. An ordinary



Device for Keeping Sand Tank Air Tight.

8-in. car brake cylinder is supported by a yoke A which attaches to lugs C and other braces to hold it in alignment. The lower end of the hollow piston rod is fitted with a regular 8-in. piston head B. It is faced off in order that a ¼-in. rubber gasket D will cover its entire surface. A retaining ring E holds the gasket by four ⅜-in. bolts.

After the tank is filled with sand, the gasket is forced against the opening by air admited to the cylinder through the ½-in. cock F. This cock has a side vent for discharging air from the cylinder when it is desired to refill it.

In the report of the Railway Master Mechanics' Committee on Fuel Economy at the last convention, they proposed a code of rules on this subject, which was ordered to be submitted by letter ballot to the members as one of the recommended practice features of the Association, and if adopted it was to be printed in a separate pamphlet for distribution to the members. The ballot confirmed the recommendation and this has been done, and a copy of the pamphlet was enclosed to each member. The pamphlets will be sold at $1.50 per 100, f. o. b. Chicago. Those requiring them should send in their orders as promptly as possible to the Secretary, Mr. Geo. W. Taylor, 1112 Karpen Building, Chicago, Ill.

THE "DYNAMITER" AND ITS ELIMINATION

By William Shriver, Air Brake Instructor, B. & O., Pittsburgh.

This is a subject in which every man connected with the operation of trains should be most deeply interested; for the "dynamiter" is properly chargeable with causing all kinds of trouble and annoyance to those who deal directly with the handling of traffic, not to mention the heavy cost to railroads in the way of damage done to rolling stock and lading, as well as that arising from delayed trains.

If the railroads of the country had in their strong boxes today only a fraction of what the "Dynamiter" has cost them in the years that have gone, they could easily make all extensions and betterments now necessary to meet the rapidly increasing demands upon our present transportation facilities, without the receipt of a single cent from bond issues, or the creation of any other form of corporate indebtedness, and still have left in their coffers a comfortable surplus with which to fatten dividends. When we stop to ponder this pregnant fact, the enormous cost of maintaining the "Dynamiter" is startlingly thrust upon our attention, and we all should readily recognize the paramount importance of its earliest elimination.

The "dynamiter" is a constant menace to the safety of transportation. It comes upon us like a thief in the night, and no one knoweth whence it cometh. It makes its unexpected and unwelcome appearance almost with the suddenness of the lightning's flash, robbing the trainman of his peace of mind, and often taking heavy toll in the shape of the lives of some, and the limbs of others. Only recently I was told of the case of a flagman who was riding in his proper place in the caboose of a train approaching a terminal. The engineer signaled for a stop, and the flagman rose to his feet preparatory to going back to protect his train. A "dynamiter" suddenly developed, throwing him from one end of the caboose to the other and breaking his neck. This incident illustrates the suddenness with which a "dynamiter" may develop at an unsuspected moment, and the awful seriousness of the consequences.

The "dynamiter," too, is born of so many different actuating causes, that, serious as are its consequences, it has been heretofore impossible to eliminate it. The discreet use of dry graphite is frequently recommended as a sovereign remedy. But this, in some quarters, much touted remedy is only temporarily effective in modifying but one of the many causes of undesired quick action; and is no more efficient for the absolute and permanent elimination from every cause and all causes combined than would be a teaspoonful of Peruna administered internally, three times a day, or the external application of Omega Oil, vigorously rubbed in, just before retiring to the train shed at night.

When a "dynamiter" occurs on a train, it must be sought for and found so that it may be cut out. Besides delaying the train, this is often a fruitless task, as many a "dynamiter" kicks itself into good behavior, and when found furnishes no incriminating evidence of having been the offender. At no time a pleasant duty, the hunting for a "dynamiter" in a long train on the "Horseshoe Bend" or the "17-mile Grafton grade" upon a dark winter night, with 18 ins. of snow and the thermometer loafing around zero, is an occupation entirely devoid of attractive features.

I believe the solution of the vexing problem of how to eliminate the "dynamiter" has been finally and successfully reached by the invention of the so-called "No-Kicker," the promising child of the inventive genius of Mr. J. Rush Snyder, Vice-President of the Pittsburgh Air Brake Company, of Pittsburgh, Pa.

Like other air brake inspectors, I some time since received a pamphlet describing the "No-Kicker." Of course I was interested, and my curiosity was aroused. At the first opportunity I visited the plant and asked for a demonstration, which was cheerfully given, and I am free to confess that I was most agreeably surprised. The demonstration was a very thorough and comprehensive one, and, to my mind, substantiated all the claims that have been made for the device in the pamphlet above referred to.

The "No-Kicker" is very simple in design, and very substantial in construction. It has but two movable parts, which move only at the time of a desired emergency, which they alone produce. It is fool-proof and can't be improberly assembled. It bolts on to any type of triple now in service without changing the service portion in any way, and without changing any of the piping connected therewith, and can be attached in a very few minutes. It is just as simple in its operation as in its construction, and does not operate except in desired emergencies, which only occur at long intervals. For this reason, its durability is practically without limit. What I also regard a very valuable feature of the "No-Kicker" is the rubber-seated, non-return check valve. Being seated in the direction of the flow of auxiliary pressure, it makes a perfect seal with its rubber seat, and prevents back leakage from the brake cylinder to the brake pipe following an emergency application or service over-reduction.

It is my best judgment that the "No-Kicker" is bound to win the unqualified approval of every up-to-date operating official of our progressive railroads, and ultimately to find universal adoption as soon as such officials become acquainted with what I and others consider its undeniable merit.

At my request a sawed section of this device, showing the internal mechanism, was forwarded to me for the information of the men of my territory, and it is a pleasure to exhibit it and to explain its operation at any time, for I believe it is going to save an immense amount of trouble and money, trouble for the traffic department, and money for the stockholders.

BOOK REVIEW

Railway Regulation: By I. Leo Sharfman, A. B. L. L. B., Professor of Political Economy, University of Michigan. Published by La Salle Extension University, Chicago. This interesting book gives an analysis of the underlying problems in railway economics from the standpoint of government regulation. It is a text book of value to railway students as well as practical railway men and discusses by chapters, the importance of railway transportation, the problem of regulation, American railway development, competition, ratemaking regulation of rates, discrimination, state regulations, conflict between state and federal authority and finally federal regulation. This book will make a valuable addition to any library which contains a collection of standard works on railway subjects as well as serving a purpose to instruct students in colleges where railway science pretends to be taught.

According to the sincerity of our desire that our friends may be true, and our companions wise—and in proportion to the earnestness and discretion with which we choose both, will be the general chances of our happiness and usefulness.—Sesame and Lilies.

HISTORY OF LOCOMOTIVE COALING APPLIANCES

Coal handling appliances for locomotives have an interesting history, which may have some degree of interest for your readers. These, for all practical purposes, may be classified under six heads. These are: First what may be called the "Armstrong" method, with a bucket holding 1,000 lbs. of coal and which was raised with an ordinary winch to a platform of suitable height, the coal being shoveled into this bucket. The shovelers then raised the coal to a platform with the winch. As many buckets being handled as was necessary to coal the locomotives, which had to be handled. This practice was quite common in early days.

The second style appeared about the year 1890. There was then installed on many railroads the link belt type of conveyor which had small buckets attached to the chain. These swept through the coal pile and elevated part of it and allowed the coal to fall into a bin. Coal from the cars was deposited in a pit 17 to 18 ft. in depth and long enough to contain the whole carload of coal. The car of coal was placed directly over the pit and coal was allowed to fall to the bottom, through breaker bars. The spaces between the bars were about 6 ins., so that the lumps could be broken through. When any side-dump or bottom-dump cars were not available the coal had to be shoveled. This device was similar to grain handling machinery seen at country elevators. . It was a vast improvement on the old method, and especially so when drop-bottom cars were available.

There was in use at this time another style of coal handling machinery, consisting of an incline where the locomotive pushed the car of coal at a 7 or 8 per cent. grade. The coal being then shoveled into bins, or if drop-bottom cars were to be had it was dropped into the bins and handled to the locomotive in the usual manner. This incline was in itself very expensive of upkeep and the maintenance of the handling crew made the cost per ton excessive.

In 1896 there was built for the Great Northern Railway in Minnesota an adaptation of the incline chute which greatly reduced the cost of handling the coal. This may be classified as the third style. The trestle used was shortened up to about 200 ft., giving a 20 per cent. grade. The coal cars were elevated by means of a wire cable and stationary engine or electric motor. The gasoline engine was found to be most suitable for this kind of work, and many hundreds of installations of this kind took place in the next six years. The entire structure was built of wood, and a large part of the timber work in the trestle was exposed to the weather, and this made the maintenance of the whole arrangement very costly, both from risk of fire and from the elements.

Larger demands, however, have sprung up for coal handling machinery for stations where only two or three hundred tons of coal are needed, and this led to the fourth style which was the bucket type and the doing away with the incline, and putting the coal bin and all the machinery in proper housing. This made the structure of much more life: such an installation allowed the coal to be deposited in an underground hopper and then elevated in buckets holding from one to two tons, by means of wire cable and stationary engine or electric motor. Where only one bucket is used it is counterweighted, but where two buckets are used they balance each other. This method proved to be very popular and produced a considerable reduction in price over the cost of the other types, especially at places where small consumption of coal is needed.

The next important step in advance was made when the wooden structure containing the coal was changed to steel or steel re-enforced with cement, making the structure fireproof and greatly increasing its life. On most railroads today side-dump or bottom-dump cars are available, which greatly reduces the cost of handling coal from the cars to the locomotive tender.

The clam or oragne-peel bucket type is in use on many railroads today for taking coal from flat cars and elevating it into the tender of the engine direct, or into small bins where it can flow to the tender by gravity. Machinery for this purpose has the advantage of being portable and can be used for other work. The disadvantage of it is that it is very destructive to the bottom and sides of wooden cars. It does not entirely clean the car, and it is very expensive in first cost and expensive to maintain the crew required to work it, as compared with the other designs.

The sixth style is the travelling or stationary gantry. This can be used for handling coal from the car to the coal chute bin and requires but one attendant for machinery having a capacity up to 40 tons an hour. It is, however, very much cheaper to install than any other permanent coal chute in proportion to the tonnage handled. The housing is made of all-steel and is therefore fireproof. The first cost is less than any other type of structure. In this case the storage of coal is in gondola cars as it comes from the mine. One great advantage is that there is no underground work and thus a very considerable part of the expense of the ordinary chute is avoided. The cost per ton for handling is about the same as in the best of the other devices. When it is desired, this gantry can be made portable, travelling on a separate track by its own power.

The railroad officials who have had most to do with bringing out these different types of structure are Mr. J. F. Stevens, Mr. E. C. Carter, Mr. J. B. Berry and Mr. W. T. Krausch, of the C. B. & Q. They have all had a hand in designing apparatus of this kind and furthermore have lent a helping hand to others who are bringing out designs.

UNIVERSITY LABORATORIES MAY HELP

In an effort to ascertain to what extent the large universities may co-operate with the representative business establishments, in the matter of industrial research, the directors of the Chamber of Commerce of the United States have voted that the questions be referred to its committee on education or to a special committee. It was arranged that the subject be taken up with educational institutions for the purpose of ascertaining the extent to which these institutions may be interested.

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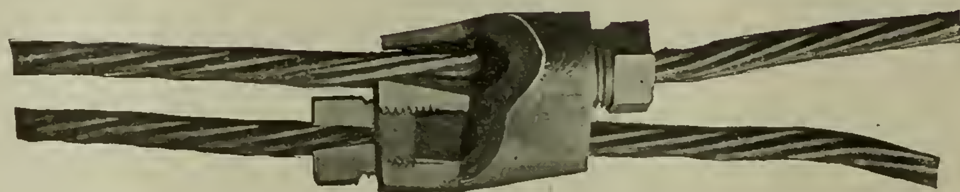

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CONTENTS

FOOD FOR REFLECTION

Railroad employes in the United States receive on the average 44 cents out of every dollar which the railroads earn, gross. In other words, practically half of the total gross earnings of the railroads is spent for labor. The other half is dispensed for material and supplies, rentals, taxes, interest and dividends.

These are interesting figures for the railroad man to consider. They prove to the world and to him that the railroad besides acting as a common carrier for the great public is of more than vital interest to the people in general and to railroad men in particular from another point of view.

Supply dealers, who furnish the materials, and the holders of railroad securities together with the State come in for but half of all the railroads earn. The employe, therefore, stands in quite as important a position as any one in the business world, or any one of those who are classed as investors. Without due consideration, one might presume that the railroad bent upon profit solely was securing its place in the sun by underpaying its employes and planning for net returns, at the expense of its servants.

To emphasize the proper situation, however, it might be of more than ordinary interest to observe that with railroad rates established as they were in 1904, the earnings for 1914 would have been larger by $160,000,000 than they actually were. Although earnings were reduced by that much the compensations paid to employes increased, in the same time, by more than $100,000,000!

The question naturally arises, does the railroad man appreciate his position? Probably not, until figures, which always tell the truth, are presented to him. When he considers, too, that in the United States the railroad employe receives seven times as much for his services as the railroad man in Japan; twice as much as the railroad employe in either New Zealand, Australia or Canada and from 25 to 40 per cent. more than the railroad employe of any other country on the globe, he may well feel proud of his occupation and his compensation. In making demands, then, for more wages and more advanced conditions in these times, it behooves railroad employes to think well before acting; to consider carefully the interests of the company which gives them steady employment and to undertake, at the same time, to aid where and when they can by reciprocal action and sentiment. He is an improvident fellow who will not secure for himself all that his services may be justly worth; but he is neither fair nor honest if he insists upon a larger compensation than his services call for. Taking the latter position he may compel his company to meet his demands, in the end, but only, as a rule, at great loss to himself and his company at the same time. In these days and in this matter let him think with more than ordinary consideration before he acts. This is not a bad rule to follow on every important occasion. Good judgment will demand it.

BRICKS WITHOUT STRAW

No man could be found today who would like to be accused of demanding that his employes make bricks without straw, and it is doubtful whether in a literal sense, such a man could be found. But there is a practice not confined to railway service which, when analyzed, savors more than a little of the old attitude of Pharaoh.

It consists, in simple English, of placing on an employe responsibility without conferring on him the corresponding authority. To demand that an engineman haul a given train over a given division in a given time, with a given coal allowance, and not give him such a measure of authority as will impress on his superiors the necessity for having the scale removed from the locomotive's boiler, if it needs such treatment to enable it to steam properly.

might be taken as one example; or to schedule a repair in a shop, and demand adherence to the schedule when lack of co-operation on the part of the stores department delays new material would provide another example; or to ask a man, whose time is planned to complete work which must be finished at a given time, to leave his bench for some little job, and not give him the authority to ask for or insist on another man on his work while he is gone, or to extend the time he has in which to complete it, would provide a third.

In these days when "efficiency" is perhaps an overworked word, a man's or a department's output for a given time is so accurately known, and this output is so regularly demanded, that there seems to be a lack of fairness in any organization where this output is demanded without giving to the man or to the department corresponding authority to prevent interruptions, and to requisition material, and help if necessary, to complete its output as required. Either the completion of the work on time is important enough to warrant the granting of authority corresponding to the responsibility, or if not, the responsibility should rest upon the superior who has the authority to provide or to restrict material and labor to insure its completion.

It has been well said that responsibility develops a man, but the real truth embodied in that idea is that the exercise of the authority commensurate and co-ordinate with the responsibility, in the fulfillment of responsibility develops a man. No more dismal conditions for a man's growth could prevail than to hold him responsible for results into which enter determining elements over which he has no control—over which by no amount of determination and personal exertion on his part has he final control.

The value of having the authority and the responsibility for a given piece of work concentrated in the same individual is obvious, when considered in the abstract. It is to these factors in the concrete, in every day railroading that attention needs to be given. There are many and diverse instances in practical railroad work which necessitate most judicious handling by the man to whom authority is delegated. He must seriously consider conditions in wielding the authority thus given him. The delays, and delays cost more money than is usually charged to them, are the result of placing responsibility where the work is, and delegating a part, at least, of the necessary authority to some point out of personal touch with the exigiencies of the progress of the work, is one of the ways that this injustice is expensive; the lack of confidence perhaps unconsciously felt in the man called responsible, with its resulting delay to his advancement is another; and the lack of self-confidence gradually instilled in the man who feels that he bears authority in name only, is perhaps the most costly of all. For hampering the development of a good man and thereby delaying his advancement either in a position or remuneration, who might with growth serve his road with greater profit to it and to him, cannot in any final sense be called economy.

It will be a sorry day for the railroads when men are needed to exercise authority and a selection must be made from subordinates who have not had the exxperience of exercising the authority corresponding to their measure of responsibility. It is detrimental to the employe who must make bricks without straw. It is worse for the employer who demands bricks without straw. And it is worst for the bricks, which represent the work turned out, for with the bricks must be built any satisfactory and permanent structure for the future.

THE TRANSPORTATION PROBLEM

President Wilson in his recent message has well said that the transportation problem in this country is exceedingly serious and pressing. No one knows this better than the active railroad manager. It is interesting to observe that the public are gradually awakening to it.

Now that the matter is fairly before Congress it is earnestly hoped that sincere efforts will be made to adjust this problem in a manner which will reflect lasting credit on our law makers and place the railroads at the same time in a position where they will stand upon a substantial footing for the benefit of the public generally as well as in the interests of the holders of railroad securities.

Any Federal regulations hereafter established therefore should be in line with requirements to be put in vogue by the various state railroad commissions in order to standardize duties and bring about a uniform adjustment of all matters which from time to time are presented. Therefore no hasty legislation should be put in force. As the President further declares the problem is one that lies at the very foundation of our efficiency as a people, and he suggests, wisely, that a commission of inquiry be provided to learn, in advance of any legislation, whether our present laws are as serviceable in every way as they might be.

This is the first time since the introduction of the Interstate Commerce Commission that a disposition on the part of the government to be fair with the railroads has even been intimated. Our great railroad systems have been burdened to death by the weight of unjust regulations, and perhaps action looking toward a betterment of conditions has come at what now might be called the psychological moment.

General Grant once declared that the best way to bring about the repeal of a bad law was to enforce its execution, and in many details, as the railroad regulations are now established, we have substantial evidence of what a bad law is. It would seem then that these regulations as enforced have been gradually reaching a point at which they will effectually kill themselves. It is not of so much consequence that new and appropriate features be added to the old ones in this matter of railroad government as it is that a complete and substantial revision of the entire law be made to suit present day requirements and place every railroad in the country where it properly belongs, permitting it to serve the great American people as a common carrier, to the best advantage and at the same time stand for reliability and responsibility among the

great mass of our citizens who have invested in its securities or are likely to so invest. In the readjustment of this all important feature of our government, the railroad men who are devoting their energies toward the public good, should be consulted fully and be allowed suggestions as to the character of any legislation to be established. The railroads and the people are too intimately related to permit any action without joint conferences.

THE POTENTIAL ENERGY OF CHEMICAL SEPARATION

In connection with the article on the formation of coal, which appears in this issue, and which gives the reader a mental picture of the process by which Nature has worked in the past and is still working, it is interesting to turn to the remarks of the committee of the Master Mechanics Association on the subject of fuel economy. The report points out the composition of bituminous and anthracite coal.

Bituminous coal is composed of about 60 per cent. carbon and about 30 per cent. of gaseous or volatile matter, which burns as flame, and 10 per cent. of earthy matter, which remains on the grates as ash. Anthracite coal contains about 85 per cent. carbon, 5 per cent. of volatile matter and 10 per cent. of earthy matter. When bituminous coal is thrown on the fire, the volatile matter is expelled, and, if properly mixed with air and heated to a sufficient temperature it will burn and pass out through the tubes and stack as vapor, leaving the solid matter on the grates in the form of coke, which burns more slowly. If, however, these gases are not consumed, they will produce smoke.

Anthracite coal burns more slowly than bituminous coal and a larger grate area has to be provided. Hard-coal burning engines must be designed so that they may consume as much coal per hour as a bituminous coal burner of the same proportions. Anthracite coal has to be fired according to the size of the lumps used; large lumps mean a heavy fire and small lumps do better when fired somewhat more lightly. In any case the burning of coal in a locomotive requires air. This must be admitted through the ash pan and grates. Smoke is caused by imperfect combustion and is waste of coal.

The evidence of coal having been associated with earthy matter in its early stages of formation is found by the examination of the ash. The residue from properly consumed coal is made up of the ashes of the original plants and also the earthy matter with which they have been associated. Its relative hardness is proportional to the earthy matter it contains. As a rule the greater the mineral impurities present, the harder it will be.

The origin of coal is the result of the transformation of woody and other vegetable matter by the elimination of oxygen and hydrogen in larger quantities than carbon, in what may be called the food of the plant. Vegetable life is, roughly speaking, like to our human method of growth and sustenance, as the process is a chemical one in each case. In presence of the actinic or violate rays of the sun, the leaves of a tree are able, by means of a secretion termed chlorophyl, to take from the carbonic acid of the air the carbon in large quantity, and reject the greater part of the oxygen, and also to split up the constituents of water, or rather the moisture it receives, and re-combine these elements in the form of carbohydrates. It thus expells the oxygen and some hydrogen.

In some coals there is an excess of hydrogen contained in the mass, and this amount is spoken of as "disposable" hydrogen, and is generally a measure of the fitness of the coal for the purpose of making gas.

The plant, however, supplied with this active secretion in its leaves; this chlorophyl, or green coloring matter, which gives to vigorous foliage its beautiful and varying tints of yellowish-green, is, by the agency of sunlight able to effect a chemical transformation on water and carbon di-oxide. This process, in some form, represents the expenditure of energy, just as when a stone is lifted from a ballast pit and placed on a flat car by a steam shovel. The stone, if thrown from the car, can do work or exert a pressure acting through distance when it reaches the ground. This is the mathematical conception of work.

The plant, in which the elements of oxygen and hydrogen have been torn from their first associates and set free in the air, has exerted a form of energy known as that of chemical separation, and with reference to the freed elements, the tissues of the plant have assumed the potential form. This potential energy is simply the ability to perform work again under appropriate conditions, just as the stone thrown down from the car, did work.

In all the natural vissitudes and strange happenings which the once living plant has undergone when it was uprooted, thrown down, disintegrated, buried and compressed to form it into coal, it has never been able to effect the recombination which would give back the carbon di-oxide and water. In its potential form, all through the lapse of ages, it has stood ready to give back in the form of light and heat the energy that was expened upon it by the rays of a long-forgotten sun and carried out by the green coloring matter of its leaves.

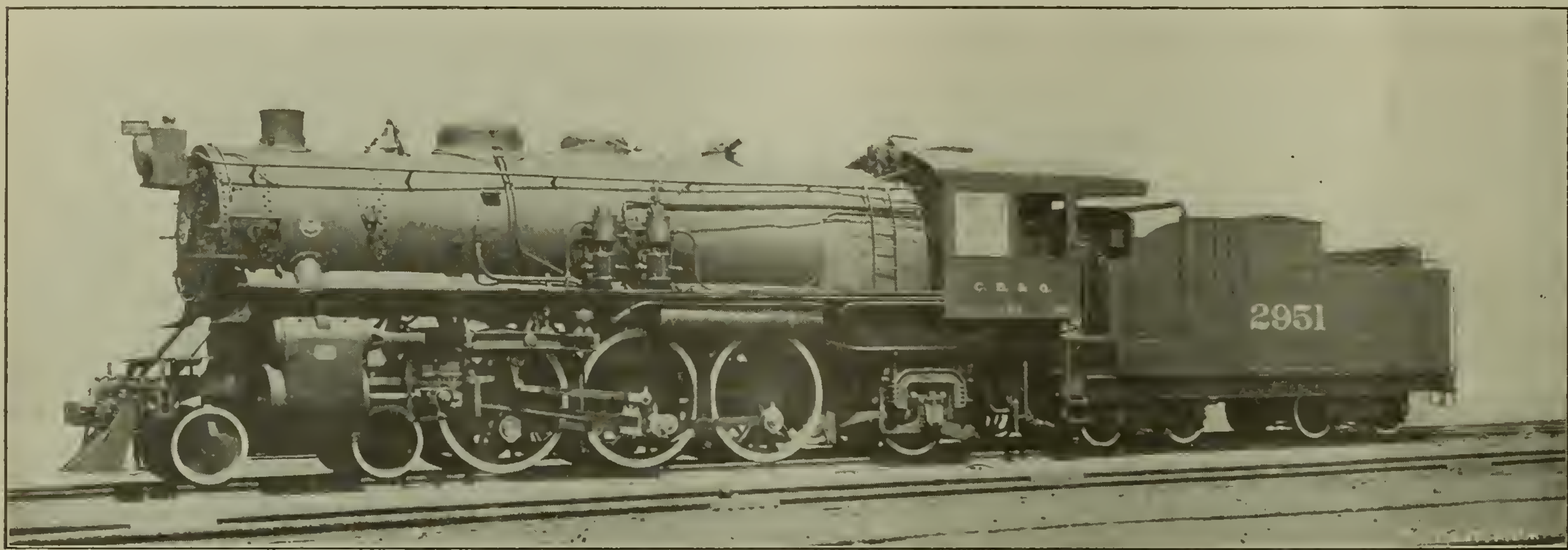
On the tender of a locomotive to-day it lies there, black and inert, but possesing the potential energy of chemical separation. It awaits only the flame-temperature of the firebox to give out its stored up or potential energy and turn it into active or kinetic form, and so speed the train along the iron roadway, bearing forward for a nation's use the products of the factory and the field.

It is believed by many railway authorities in Great Britain that the present abnormal prices for sleepers or ties will be maintained for at least one or two years before they again reach the normal range of quotations, says a recent Commerce Report. This is from a statement issued at Ottawa by the Canadian Government trade commissioner in London. His report is published in great detail in a somewhat recent number of the Weekly Bulletin of the Department of Trade and Commerce, Ottawa.

Baldwin Locomotives for C. B. & Q.

The Chicago, Burlington & Quincy Railroad have recently received fifty-five locomotives from the Balwin Locomotive Works, of Philadelphia. Several designs are here represented: Fifteen Pacific type, for passenger service, 4-6-2; fifteen Mikado type, for freight service, 2-8-2; fifteen 2-10-2 type, for freight service (five of these will be used on the Colorado & Southern); ten Mikado or 2-8-2 type, for freight service on the Ft. Worth & Denver.

. Special interest centers about the Pacific, or 4-6-2, type of locomotives, which represent a new design, while the Mikado and the 2-10-2 type locomotives are closely similar to engines previously built for this system. The Pacific type locomotives exert a tractive force of 42,200 lbs., and were designed to weigh approximately 170,000 lbs. on the driving wheels, with a limit of 60,000 lbs. on any one pair. Special attention has been given to the design of the reciprocating parts and other machinery details, with a view to reducing as far as possible what has been called the "dynamic augment," on the rail, when running at high speeds. The locomotive throughout is an excellent example of a high-power passenger engine, designed to develop maximum power in proportion to its weight, but having no complicated or untried features.



F. A. Torrey, S. M. P. Fast 4-6-2 for the Chicago, Burlington & Quincy. Builders, Baldwin Loco. Works.

F. A. Torrey, S. M. P. Heavy 2-8-2 for the Chicago, Burlington & Quincy. Builders, Baldwin Loco. Works.

The boiler is of the extended wagon-top type with a combustion chamber. The barrel is composed of three courses, the first course being sloped on top and the third on the bottom. This construction provides ample steam space, and also a free entry to the throat sheet under the combustion chamber. The heating surface is not exceptional for a boiler of this size, but it is so disposed that free steaming is likely to result. The tubes are of moderate length, and no attempt has been made to crowd them so as to hamper circulation. The firebox contains a brick arch, which is supported on angle irons. The railroad company's standard design of smoke consumer is applied, with four inlet tubes on each side of the firebox. The main dome, which is of pressed steel, is on the second boiler course. The auxiliary dome is on the third course, and is placed over a 16-inch opening in the shell, so that the boiler can be easily entered for inspection purposes.

Mention has been made of the special attention given to the design of the reciprocating parts and machinery. The pistons have a dished section and are of 40 per cent carbon cast steel, carefully annealed; they have iron bull-rings cast on them. No extension rods are used, but the bull-rings are widened at the bottom, from 4½ to 6 in. The piston rods are of "nikrome" steel, 4¼ ins. diameter,

hollow bored, with 2½-in. holes. They are forced into the heads under a pressure of 35 tons. The cross-heads are of the same material as the pistons; they are of the Laird type, with bronze gibs; the lug for the union link is cast in one piece with the cross-head body. The cross-head pins are of "nikrome" steel," hollow bored. The main and side rods are also of "nikrome" steel, the main rods having an I-section, while the side rods are rectangular. The main stub, or butt end, of the connecting rod is of the strap type, with wedge adjustment. The front side rod tapers in depth from 5 ins. at the front to 6½ ins. at the back, with a uniform width of 1⅝ ins. The crank-pins and side-rod knuckle pins are of "nikrome" steel, hollow bored. Walschaerts valve motion is used, and the gears are controlled by the Ragonnet power reverse mechanism.

As actually balanced, the dynamic augment, at a speed of 70 m.p.h., amounts to approximately 38 per cent of the static weight for the front and back driving wheels, and 28 per cent for the main wheels. The proportion of the reciprocating weight that has been balanced is 61 per cent, and this is equivalent, on each side, to 1-202 of the total weight of the engine. The following actual weights are of interest in this connection: Piston and rod complete, with cross-head key, 557 lbs; cross-head, 414 lbs.; main rod, 870 lbs.; side rod weight on front crank-pin, 158 lbs.; side-rod weight on main crank-pin, 490 lbs.; side-rod weight on back crack-pin, 168 lbs:; crank-pins complete—front 125 lbs., main 295 lbs., back 130 lbs.

The cylinders are cast from the same pattern as those used on the Mikado type locomotives for the Fort Worth and Denver. They are fitted with vacuum relief valves, but no by-pass valves are used. The guide for the valve-stem cross-head is cast in one piece with the back steam-chest head.

The frames are of .40 per cent carbon cast steel, ennealed, and manufactured to specifications prepared by the American Society for Testing Materials. The main frames are 6 ins. wide. The rear sections are of slab form, arranged to accommodate the Rushton type of trailing truck with outside journals. In the present example the truck is fitted with three-point suspension links. The frames are braced transversely at the front and main driving pedestals, also by the guide yoke, valve motion bearer, and a waist-sheet cross-tie placed between the main and rear pairs of driving-wheels. At the splice between the main and rear frames is placed a strong transverse casting, which contains a pocket for the rear truck radius-bar pin, and also supports the front of the firebox through a vertical expansion plate. The pedestal shoes and wedges are of bronze. The driving wheel centers are fitted with bronze hub plates, and the driving axles are of chrome-vanadium steel, heat treated and hollow bored.

The equalization system is cross-connected between the rear driving-wheels and trailing-truck. A central, vertical link connects two transverse beams. The upper beam is suspended from the rear driving springs, while the lower beam is connected, by means of a vertical link on each side, with the rear truck equalizers. These are placed on an angle, so that they can connect with the truck spring hangers, which are placed outside the wheels. This construction, while maintaining the desired weight distribution between the driving-wheels and rear truck, prevents any rocking action on the part of the driving-springs from being transmitted to the truck springs, or vice versa. The locomotive should, therefore, be a steady riding machine. The tender is equipped with a coal pusher, and is carried on equalized pedestal trucks. The wheels are of forged and rolled steel, manufactured by the Standard Steel Works Co.

These locomotives were designed by the builders, in consultation with Messrs. F. A. Torrey, Superintendent of Motive Power, and C. B. Young, Mechanical Engineer, of the railroad. The practice of the Burlington, as far as details are concerned, has been closely followed. The result is a locomotive which is specially fitted for the conditions to be met, and which has been designed in the light of an unusually wide experience.

The principal dimensions of these locomotives, and also of the freight engines to which reference has been made, are given in the table:

2-8-2 Type Freight Locomotive for the Fort Worth & Denver.
L. L. Dawson, S. M. P. & Cars. Builders, Baldwin Loco. Works.

TYPE 4-6-2.

Gauge, 4 ft. 8½ ins.; cylinders, 27 ins. x 28 ins.; valves, piston, 14 ins. diameter. Boiler.—Type, wagon-top; diameter, 78 ins.; thickness of sheets, ¾ in. and 13/16 in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial. Firebox.—Material, steel; length, 108¼ ins.; width, 78¼ ins.; depth, front 85¾ ins., back 72 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in. Water Space.—Front, 6 ins.; sides, 6 ins. to 4 ins.; back, 4 ins. Tubes.—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G., thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 34; 2¼ ins., 200; length, 18 ft. 6 ins. Heating Surface.—Engine equipped with Schmidt superheater; superheating surface, 751 sq. ft.; firebox, 233 sq. ft.; combustion chamber, 59 sq. ft.; tubes, 3,072 sq. ft.; total, 3,364 sq. ft.; grate area, 58.7 sq. ft. Driving Wheels.—Diameter, outside, 74 ins.; diameter, center, 66 ins.;

journals, main, 11 ins. x 12 ins.; journals, others, 10 ins. x 12 ins. Engine Truck Wheels.—Diameter, front, 37 ins.; journals, 6 ins. x 12 ins.; diameter, back, 48¼ ins.; journals, 8 ins. x 14 ins. Wheel Base.—Driving, 13 ft.; rigid, 13 ft.; total engine, 33 ft. 8½ ins.; total engine and tender, 65 ft. 10¾ ins. Weight.—On driving wheels, 169.700 lbs.; on truck, front, 47,800 lbs.; on truck back, 48,900 lbs.; total engine, 266,400 lbs.; total engine and tender, about 425.000 lbs. Tender.—Wheels, number, 8; wheels. diameter, 37 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,200 gals.; fuel capacity, 13 tons; service, passenger.

TYPE 2-8-2.

Cylinders, 28 ins. x 32 ins.; valves, piston, 14 ins. diameter. Boiler.—Type, straight; diameter, 88½ ins.; thickness of sheets, ⅞ ins.; working pressure, 180 lbs.; fuel, soft coal; staying, radial. Firebox.—Material, steel; length, 117 ins.; width, 96 ins.; depth, front, 91½ ins.; depth, back, 76¼ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in. Water Space.—Front, 6 ins.; sides, 6 ins to 4 ins.; back, 4 ins. Tubes.—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins. No. 9 W. G.; thickness, 2¼ ins., No. 11 W. G.; Number, 5½ ins, 45; 2¼ ins., 264; length, 18 ft. 7¼ ins. Heating Surface.—Engine equipped with Schmidt superheater; superheating surface, 1,005 sq. ft.; firebox, 277 sq. ft.; combustion chamber, 69 sq. ft.; tubes, 4,080 sq. ft.; fire-brick tubes, 39 sq. ft.; total heating surface, 4,465 sq. ft.; grate area, 78 sq. ft. Driving Wheels.—Diameter, outside, 64 ins.; diameter, center, 56 ins.; journals, main, 11 ins. x 12 ins.; journals, others, 10 ins. x 12 ins. Engine Truck Wheels.—Diameter, front, 37 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42½ ins.; journals. 8 ins. x 14 ins. Wheel Base.—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 35 ft. 9 ins.; total engine and tender, 67 ft. 6¼ ins. Weight.—On driving wheels, 239,900 lbs.; on truck, front, 28,000 lbs.; on truck, back, 47,500 lbs.; total engine, 315,400 lbs.; total engine and tender, 497,500 lbs. Tender.—Wheels, number 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 9,200 gals.; fuel capacity, 20 tons; service, freight.

TYPE 2-10-2.

Cylinders, 27 ins. x 30 ins.; valves, piston, 14 ins. diameter. Boiler.—Type, wagon-top; diameter, 78 ins.; thickness of sheets, ¾ in. and 13/16 in.; working pressure, 180 lbs.; fuel, oil; staying, radial. Firebox.—Material, steel; length, back, 108⅛ ins.; width, 72¼ ins.; depth, front, 84⅜ ins.; depth, back, 72⅝ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in. Water Space.—Front, 6 ins.; sides, 6 ins. to 4 ins.; back, 4 ins. Tubes.—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness 2¼ ins., No. 11 W. G.; Number, 5½ ins., 34; 2¼ ins, 200; length, 21 ft. Heating Surface.—Engine equipped with Schmidt superheater; superheating surface, 834 sq. ft.; firebox, 215 sq. ft.; tubes, 3,488 sq. ft.; total, 3,703 sq. ft.; grate area, 54.2 sq. ft. Driving Wheels.—Diameter, outside, 64 ins.; diameter, center, 56 ins.; journals, main, 11 ins. x 12 ins.; journals, others, 10 ins. x 12 ins. Engine Truck Wheels.—Diameter, front, 37 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42½ ins.; journals, 6 ins. x 14 ins. Wheel Base.—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 33 ft., 9½ ins.; total engine and tender, 65 ft. 11¾ ins. Weight.—On driving wheels, 213,150 lbs.; on truck, front, 25,500 lbs.; on truck, back, 34,200 lbs.; total engine, 272,850 lbs.; total engine and tender, 434,000 lbs. Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, water 8,200 gals., oil 3,050 gals. Service, freight.

TYPE 2-10-2.

Cylinders, 30 ins. x 32 ins.; valves, piston, 15 ins. diameter. Boiler.—Type, straight; diameter, 88½ ins.; thickness of sheets, ⅞ in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial. Firebox.—Material, steel; length, 132 ins.; width, 96 ins.; depth, front, 89¾ ins.; depth, back, 75 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in. Water Space.—Front, 6 ins.; sides, 6 ins. to 4 ins.: back, 4 ins. Tubes.—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 45; 2¼ ins., 264; length, 22 ft. 7½ ins. Heating Surface.—Engine equipped with Schmidt superheater; superheating surface, 1,232 sq. ft.; firebox, 272 sq. ft.; combustion chamber, 68 sq. ft.; tubes,

H. W. Ridgway, S. M. P. Builders, Baldwin Loco. Works.

Heavy Freight 2-10-2 for the Colorado & Southern.

4,966 sq. ft.; fire-brick tubes, 43 sq. ft.; total, 5,349 sq. ft.; grate area, 88 sq. ft. Driving Wheels.—Diameter, outside, 60 ins.; diameter, center, 52 ins.; journals, main, 12 ins. x 12 ins.; journals others, 11 ins. x 12 ins.. Engine Truck Wheels.—Diameter front, 34 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42½ ins.; journals 8 ins. x 14 ins. Wheel Base.—Driving, 20 ft. 9 ins.; rigid, 20 ft. 9 ins.; total engine, 40 ft. 1 in.; total engine and tender, 74 ft. 9¼ ins. Weight.—On driving wheels, 295,950 lbs.; on truck, front, 25,200 lbs.; on truck, back, 46,700 lbs.; total engine, 367,850 lbs.; total engine and tender, 562,000 lbs. Tender.—Wheels, number, 8; wheels, diameter, 34 ins.; journals, 6 ins. x 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 20.8 tons; service, freight.

RAILWAY AND ELECTRICAL SUPPLIES

American railway and electric supplies are being favorably received in China, and large purchases will necessarily have to be made in the near future, particularly for the necessary upkeep of railroads now in operation. This may be gathered from a recent issue of the Government Commerce Reports. The local managers of American enterprises are alert and capable of securing and holding available and desirable trade. This is also the case as regards numerous other lines. Shanghai alone imported about 50,000,000 ft. of Pacific coast lumber last year, and the trade is growing because of an aggressive selling campaign. Through American manufacturing and exporting connections in the United States, coupled with local American representation in China, the foundation is already prepared for increased participation in profitable business. Generally, conditions are favorable.

The Theory of Coal Formation

Among the several theories as to the process of Nature in the formation of coal, one put forward by W. Mattieu Williams in 1855 seems to be in the highest degree probable, as it gives one a picture in brief of the age-long procedure of the slowly acting agencies which buried the forests of the past and packed them down beneath heavy strata of rocks, to be at last our source of heat and light and power.

Among his many walking tours he visited one of the lakes of North Tyrol. This lake, the Aachensee, lies between high precipitous banks which slope down below the surface at approximately the same angle that they have above it, and the steep slopes, especially on the heights, are richly wooded. Being an expert swimmer, Williams made observations while bathing, and his careful inspection of the bottom of the lake was assisted by the remarkable transparency of the water. The appearance of the whole of the sub-aqueous region presented a strange and interesting condition.

The bottom of the lake was strewn with branches of trees, trunks, stumps and quantities of vegetable debris. In some places the accumulation of trees was almost in forest-like profusion. Many of these stood in an upright position, some stripped of branches, others with only a few attached. The roots were buried in the soft mud, and this position of the trees at first seemed to suggest that they had once grown where they stood. Other trees were at various angles and some were lying flat. The mud at the bottom of the lake consisted of a loamy powder with particles of vegetable matter and thin scaly fragments of leaves and bark.

The wood of these submerged trees was dark, the bark was gone and the layers, representing the yearly addition to the growth of the tree, were loosened and could be easily separated by hand and broken off. This condition arises from the successive and easy softening of each ring. A piece of wood brought to the surface was so completely water-logged that it sunk at once on being released. The whole of this sub-aqueous deposit was slowly loosening and breaking up, and mingling with the matter on the floor of the lake, forming in time a thick heavy vegetable mud.

Further inspection revealed the fact that the trees could not have grown where they stood at the bottom of the lake. The steep and precipitous slopes, heavily wooded above, were broken, and plainly marked with long wide paths which were the tracks of mountain torrents and streams. The edges of these denuded paths were strewn with uprooted and fallen trees, which gave a clue to the action of the wild streams, in hurling down into the lake trees, stones, earth and all that might temporarily bar the way. Trees so torn from their original position carried with them stones and earth adhering to their roots, and when the trunk floated out on the lake the encumbered roots held the trees in an upright position until they became gradually saturated with water and slowly sank down, still vertical, and at last disappeared to finally stand upon the bottom of the lake, many fathoms below the surface.

In Norway practically the same conditions are to be seen, even on a larger scale. Here are the same precipitous forest-crowned heights sloping down to narrow, deep fiords, or arms of the sea which stretch far inland from the ocean. The fiords are deep, narrow and long, and the water might not inappropriately be said to stand upon its edge. In the Storfjord and its extensions, for example, the strips of denuded forest-ground were large and wide and clearly marked. Farm houses and other buildings were placed by the inhabitants so as to be clear of the periodic vegetable avalanches carried down by storm water and torrent.

This process, fairly well within the reach of present-day observation, has been going on practically without interruption for at least the whole of the present geological era. Tons upon tons of vegetable matter have been swept down into the fiords, not only in Norway but in other parts of the world where the formation of the earth permits the sea to run its lancet-like blads of water far inland. The steep banks preserve the same angle of slope above and below the water and reach a depth of many thousands of feet. Much loose, stony and earthy matter clinging to the trees, drops off as they float out on the surface, so that while the trees gradually tend to reach the central portion of the fiord or at least some distance from the shore, before they become water-logged, the earth and stones sink down quickly and lie on the bottom near where the torrent reaches the water.

The net result of all this is that the sunken trees are disposed of pretty evenly over the bottom. Toward the central area they form at length an almost purely vegetable deposit, mingled with only a small portion of the mineral matter which is held in suspension or still holds to the roots. This mineral matter in the form of impalpable particles, has a chemical composition similar to the rocks near by. Close to the shore, a different compound deposit is formed, consisting of trees, fragments of limbs, twigs, leaves and other vegetable matter mixed with a far larger amount of mineral substance than that which reaches the central area.

In the orderly process of Nature it is inevitable that the nearly pure vegetable deposit practically now a sort of vegetable mud, in the central area, or at least some distance away from the land, must be gradually covered up by the deposit, consisting largely of stones, earth or other minerals, which is laid down where the torrent reaches the lake or the fiord. This mineral aggregation, constantly added to, as the stream rushes into the tranquil water, creeps slowly but steadily outward from the shore. In time, measured by the lapse of ages, the fiord will be filled up all but a water-way made by the flowing stream. Long before this the buried and pulpy fragments of the once luxuriant forest of the heights will be covered up beneath the sands and earth and glacial mud, and all will be consolidated into coal below, and rock above, as the clock of the great universe counts out its centuries of time.

The presence of the advancing shallows are to be seen to-day in the deposits brought down by the Storelv which flows down the Justedal, receiving the outflow from its glaciers. The waters of the Lyster fiord into which the Storelv flows are now whitened for two or three miles from the mouth of the river. This discoloration of the water is caused by the presence of minute particles of mineral matter, and if the process continues long enough, this earthy material will extend all over the fiord, and at length sink down on top of the vegetable deposit on the bottom. It and the advancing shallows from the river mouth will at last slowly entomb the well preserved vegetable bed, under what will one day be known as stratified rock. The enclosed mass cannot rot or chemically combine with other substances. It will be consolidated by the weight of the matter above it, and it will become

dry and hard, as the fiord or lake water is pushed out by the growing accumulation of earth and bowlders. Thus the soft vegetable mud will at length form coal, as we know it. The portion found above the true coal seam, made up of part coal and part earth, will be formed by trees and limbs imbedded before they have fully become soft or have broken up.

This ingenious and highly probably theory of the formation of coal seams and the coal measures around and above them is perhaps but a brief and disjointed outline, as here stated, but it is most likely correct and bears out the conclusion that the formation of coal is due to the agency of water. We have seen that even in the formation of the purest coal there is a small admixture of mineral matter, and the ash derived by the burning of coal proves beyond doubt that it is not composed exclusively of the ashes of plants. Ordinary coal-ash nearly corresponds to or at least shows its connection with the rocks with which it is associated. The ash from a cigar is the result of burning pure dry vegetable matter. It would, in sufficient quantity, form a good fertilizer. Not so with coal ash, part of it is mineral matter and this comes from the solid material deposited at the same time that the vegetable pulp is formed.

We have first the floor of the lake or fiord, which is the under clay, made up of mineral matter, a few fossils and some vegetable debris. Such a bed of dark consolidated clay is found under every coal seam, and when man digs for coal, this clay becomes the floor of the coal-pit. Next there is the oblong basin-form common to true coal-seams, and this suggests the lake or fiord as the original mould in which the plastic mass of vegetable matter was held while forming into coal, and lastly we note the obliteration of all semblance to tree-like form in the coal seam proper, while such fragments, well preserved, are found above and below the mass of coal. This strengthens the plausibility of the whole theory.

This picture of the formation of coal would not be complete if it was not pointed out that the great carboniferous period in the earth's history when our coal was made, was one of profuse and luxuriant vegetation. Not only was there a bewildering variety of plants in those far off days, but the humbler forms of plant life, as we know them, such as ferns and fern-allies, emancipated from the mediocrity of small herbs grew up as great trees. Plants of the club moss type then rose from fifty to seventy feet in height. Reed-like jointed plants and those allied to grasses, became branching trees and everywhere great size and rich profusion reigned supreme.

Hugh Miller, a Scottish geologist who died in 1856, speaking of the vegetation from which our coal is derived, said: "In no other age did the world ever witness such a flora; the youth of the earth was peculiarly a green and umbrageous youth, a youth of dusk and tangled forests. Wherever dry land or shallow lake or running stream appeared, from where Melville Island now spreads out its ice wastes under the star of the pole, to where the arid plains of Australia lie solitary beneath the bright cross of the South, a rank and luxuriant herbage cumbered every footbreadth of dank and steaming soil; and even to distant planets our earth must have shone through the enveloping cloud with a green and delicate ray."

The common forms of coal are, first, anthracite, which contains about 90 per cent. of carbon; and second, bituminous coal. The name for this is derived from a misapprehension of what takes place when this form of coal is burnt. It possesses the property of softening and apparently fusing when heated to a temperature below that at which true combustion takes place. This low temperature nevertheless marks the point at which destructive distillation begins. That no bitumen exists in this coal is proved by the fact that ordinary solvents for bituminous substances produce no effect. Lignite and cannel are usually dull and earthy, and the carboniferous shales are far inferior to true coal.

From our brief resume of the process of coal formation, the reason for these differences in commercial availability are clearly indicated. One would imagine that anthracite coal, with its high percentage of carbon, might have been formed where the accompanying deposit of mineral matter was small. Bituminous, perhaps, next in order, had a somewhat greater mineral deposit laid down with it and was richer in hydro-carbon, while the lignites, cannels, and shales are more or less imperfectly formed coals. The different varieties of coal contain carbon, hydrogen, oxygen and nitrogen, in various proportions, but the fundamental characteristic which is of use to us, is that in a state of nature the plant separated out and retained the bulk of the carbon from the carbonic acid of the air, and took the hydrogen from the moisture it received. These it stored up, untouched by the vicissitudes of its sub-aqueous treatment. Now, in our time, these elements thus dissociated from one another ages ago, in the presence of the sunlight of that far-off time, still stand ready to recombine when the temperature conditions are supplied, as they are in the firebox of a locomotive. This reuniting of the hitherto separated elements takes place very rapidly to-day. The tardy and long sustained process of selecting, preserving and consolidating the ancient carboniferous mud into coal may be reversed in so short a time within the furnace, fed by a steady fireman, that the age-enduring work of a long distant past may be made to give up in an hour's run the work performed so slowly and so gradually by Dame Nature in the days when the earth was young.

ENTITLED TO HONOR

Like the oldest inhabitant in any community the oldest railroad is entitled to especial honor and respect. When the Baltimore & Ohio issued its eighty-ninth annual report this year it could lay claim without dispute to being the oldest railroad in the United States. Chartered in 1827 it began construction July 4, 1828, and Charles Carroll, one of the signers of the Declaration of Independence, assisted in laying the first rail. This event, signalized by the date, and the remarkable character who drove the first spike, is worthy of more than ordinary consideration. To-day the Baltimore & Ohio with nearly 5,000 miles of railroad is one of the foremost systems in the country with a close touch on Baltimore, Philadelphia, Washington, Cincinnati, Chicago and St. Louis, serving millions of people and covering nearly a dozen states of the Union with its net work of tracks. In less than one hundred years it has seen all these cities rise from unnoticeable hamlets to first places among the great cities of the world. And in paying distinguished honor to the Baltimore & Ohio we must remove our hats at the same time to all the railroads of the country which have been the direct means of introducing civilization in a once barren waste and of building up and maintaining one of the great powers of the world.

We have many goodly days to see: the liquid drops of tears that you have shed, shall come again, transformed to orient pearl; advantaging their loan, with interest, often-times-double gain of happiness.—Richard III.

THE HAYES DERAIL

The Hayes derail has a variety of uses, and it is simple enough in its construction not to require a great deal of attention. It is practically a rough casting bolted to a tie or ties, and is composed of what one may call a seat and a flap-over derailing portion. When the derail is down in position, it lies on the top of the rail and has a short, easy incline and a flange-way which takes a wrongfully intruding wheel off the track and sets it on the ties, and by this act it halts the mistaken operation.

The derail can be used instead of the split or tapered derail at interlocking points, or it can be employed to keep cars from reaching the "fouling point" on converging tracks. When the Hayes derail is thrown back, it is out of the way. There is no very close fitting required in putting the parts together, and it does not require to be kept constantly oiled. A little oil does no harm, but it is not by any means essential, and as the whole apparatus is short and compact, it is easily kept clean in winter, and it cannot freeze up solid so as to cause any inconvenience or difficulty in getting it loose.

Another excellent use it can be put to is on a railway repair track. Here it forms a most effective protection for the lives and limbs of the repair men. When cars are put in the repair track, the engine backs out, the derail is put down and the repair track is thus isolated as completely as if it had no connection with the outer world. With this form of derail the makers supply when requested what they call a banner. It is merely an indicator made of flat iron, and is riveted to a square iron upright. When the derail is down and the track protected, this banner shows broadside, and when the track is clear it shown only its edge, like a switch target.

The indicator is painted blue, which is the car repairer's color, and the word "Stop" in white is conspicuously displayed on the banner or target. Any kind of lettering may be used or the whole indicator may be made of blue enamel if desired. No matter how the word is shown, the car repairers work safely behind the blue color, beyond which a switchman is forbidden to trespass, and with the direct protection of the device.

This derail is also used at turn-tables. At or near the turn-table a derail is placed on each track, so that an engine starting to come out of the house on its own account, due to a leaky throttle, or other causes, is stopped before reaching the turnable pit. The efficacy of this device appeals to anyone who has seen it—everybody has not—its use may substitute a short temporary delay to one engine instead of a tie-up of several hours' duration for the whole of the power. It is a useful thing as a turn-table adjunct, and there are a great many locomotive foremen who would be glad to have a chance to use it.

SOME INTERESTING FIGURES

Women holders of railway securities are very much in evidence. Noticeably so, so far as shares of Lehigh Valley stock are concerned. Nearly 41 per cent. of this stock is held by women, and the number of such holders is steadily increasing.

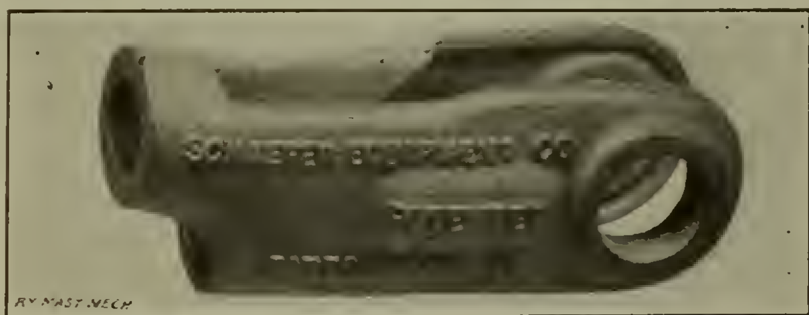
In November last there were 8,832 stockholders, all told, on the books of the Lehigh Valley, an increase of nearly 900 over the previous year. Five years ago the Lehigh Valley had but 3,796 stockholders. When shares like the Lehigh Valley sell at comparatively low figures, as they have, off and on, the past few years, it is always an inducement for those of limited means to invest their idle holdings of cash in them—a perfectly safe thing to do, as a rule. This undoubtedly accounts for such a large increase in stockholders of the Lehigh Valley.

BRAKE EQUIPMENT PARTS

One of the many efforts for the gaining of lightness, while equalling, or even excelling, the strength of existing parts of railway brake rigging, is the solid forged truck lever, now handled by the Schaefer Equipment Company. This concern has taken up new quarters at 2143 Oliver Building, Pittsburgh, Pa. The truck-lever connection or bottom brake rod is a flat steel bar, blanked, and the ends are drop-forged so as to form the jaws with boss for

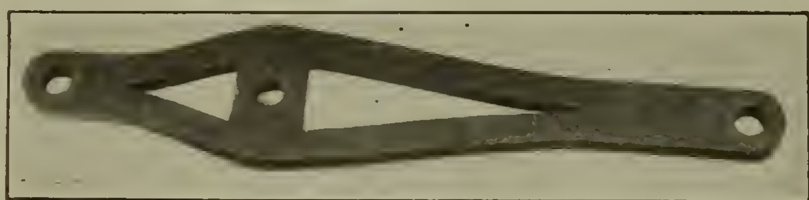
Bottom Brake Rod.

pin-hole and a bent-out piece, making a short groove into which one might lay a finger. This form strengthens the jaw without increasing its weight. The flat steel bar is then bent into a U-shaped form and the edges closed in to make a circular section. The seam is at the underside, and rain and snow cannot enter.



Cylinder Push Rod Jaws.

The company also makes cylinder push rods in the same way with attachable brake jaws. This device is of peculiar shape and is quite ingeniously formed, as shown in our illustration. The bottom brake rod is made of any desired length or offset, and is also illustrated. A flat



Truck Lever.

bar is by this company's process easily converted into the strut-type brake lever of characteristic design. Some interesting tests have been made on this simple form of lever by the Pittsburgh Testing Laboratory.

INCLINING THE RAILS

At the recently held Roadmasters' Convention the question of canting the rails was brought up, and it was thought advisable to adhere to the present method of laying the rails so that the rail was kept vertical. Nevertheless several interesting questions at once came up in this connection, and we invite any of our readers who have anything to say on the subject to write us now.

European practice makes the inclined rail a standard method of procedure. In this our friends who favor the inclined rail see a method that they think we might copy with advantage. The coning of the wheel in Great Britain and on the continent is practically 1 in 20 and the rail is so placed as to have the surface of the head normal to the coned tread, thus reducing the leverage tending to bend the axle.

Before considering the matter further it is well to have a clear understanding as to why the wheel tread is

coned at all. The answer usually given when a question on the subject is asked is to say that the coning of the wheel tread reduces flange wear and saves the rail. This is true as far as it goes, but the fuller explanation involves the fact that with properly coned wheels and a straight track, the coning of the tread, theoretically, allows the truck to run along the track without any flange on the wheels. The flange is thus, by this view, a safety device, occasionally called into action on straight track and nearly always on curves, but the bulk of the work of guiding the wheels is performed by the coned tread.

On a straight track, suppose each wheel stands, with tread circumference equal, and as the car proceeds any tendency to roll off the equal circumference line is automatically checked because if the right wheel presents a larger circumference to the rail the left wheel necessarily presents less than it did. In other words, the right wheel becomes, for the moment, larger than the left, and the wheels at once begin to roll off the right rail and approach the left, and when the left wheel becomes the larger it tends to roll off the left rail and toward the right again.

The coned wheels are forever trying to adjust their circumferences, and the result is a slow, gentle, swaying of the vehicle first toward one rail and then toward the other, and where the track is good the flange may not be called into play. On curves the larger circumference of the outer wheel, where the tread joins the flange, acts in conformity with the greater length of the outer rail, and the flange and throat complete the work of guiding so that the car stays on the rails.

This is the good office performed by the coning on the wheel tread, and it takes place without reference to how the rail stands and is indifferent to the shape of the head. It is entirely a wheel function. The M. C. B. standard wheel tread is coned 1 in 20, similar to that of European practice. At the June, 1915, convention of the M. C. B. Association a suggestion was made to alter this coning to 1 in 40. The answer of the Committee on Wheels was: "A communication has been received from one of the roads, a member of this Association, criticizing the present standard taper of tread of 1 in 20, and recommending that change be made to 1 in 38, the claim being made that the present standard taper is responsible for increased rail renewal, and is also more severe on the wheel itself. It is the opinion of your committee as a whole that any reduction in the taper of the tread will be detrimental to the wheel, but that if it can be shown that such change would be of sufficient benefit to the rail as to offset any bad effect on the wheel, they would be willing to consider such change."

This is the opinion of a responsible committee which has studied the question and speak with authority. We have here glanced at the good effects of tread coning and have observed that the credit belongs to the wheel. We may, however, state the belief of many, that the inclined rail offers a sort of co-operative benefit to the action of the wheel, while protecting itself. In the nature of the case the relative position of wheel and journal is not, and cannot be, theoretically desirable. The weight acting downward on the brass is carried to the wheel, and the support of the rail is not in line with that through the center of the journal. A certain tendency, therefore, is always present, and its action in extreme cases would be to bend the axle. The power of this tendency is measured by the distance between a vertical line through the center of the load on the journal and the tread resting on the rail. Any reduction of this distance must necessarily reduce the tendency to bend the axle, and is therefore not only beneficial, but strictly scientific.

When the rail is inclined inward so that the head more nearly conforms to the coning of the tread, this distance is lessened and the wheel stands with better bearing on the rail. Its inclined position places the rail so that it can better resist the wedging action of coned tread on the nearly flat head of the rail. This wedging action tends to overturn the rail or cause it to "roll out." The inclined rail and the coned tread with their improved bearing surface places the load on the rail in the position where the rail can best exercise its function as a steel beam and where it will bring the wear more to the center of the rail and reduce flange wear. This position reduces the tendency to bend axles and by confining the wear to a particular zone reduces flange rubbing, and thus prolongs the life of the wheel.

The effect of coned wheel and inclined rail, as we have seen, saves the wheel from a certain amount of flange rubbing, and the rail benefits from the same cause. The friends of the inclined rail hold that by thus removing rail wear from one edge to the center the danger of broken rails due to the formation of transverse fissures is greatly reduced. In other words, the rail is believed to be free from the chance of splitting, and the pressure on the base of the rail is more correctly and evenly distributed when the base is normal to, or in line with, the load put upon it by the wheel.

It is further claimed by advocates of the view that the inclined position of the rail is more scientific than the vertically placed rail, that old rails and worn wheels would benefit if the change was made. The zone of wear would be shifted, and a new rail surface would come into use which had not been touched previously. The effect on the wheel would be somewhat similar, but during the process of wearing in the new position the wheel would have a decreased axle bending tendency, for the reason that the leverage between the center of the journal and the point of support on the rail would be actually lessened.

This whole question is well worthy of the most careful consideration. The inclined rail position is backed up by the force of enlightened European practice, and while many of their methods would not suit American conditions, this one, that of the inclined rail, does not seem to be among the number. We would be glad to hear from any of our readers who is in a position to express an opinion and to help forward the discussion.

GOOD RECORD OF G. T. R. FIRE BRIGADES

Mr. W. D. Robb, superintendent of motive power of the G. T. R., announces that two of the annual fire bridgade competitions for employes of that system have been won this year by the men of the car shops at London, Ont. Employes' fire brigades at the various main repair shops, round house terminals and other large buildings have long been an institution on the Grand Trunk. The organization comprises hose and hook and ladder companies, the members of which are supplied with coats, helmets, rubber boots, etc. The men are regularly drilled and reside within easy distance of the shops in order that they can respond promptly to an alarm.

The company recognizes the work of the men composing these fire brigades in many ways, granting additional free transportation to them and their families and also awards prizes in the annual competitons amunting to $250. The "dry" race was won this year by No. 2 Company of the car shops at London, and they were also winners in the "wet" race, while the hook and ladder race was won by a Montreal team from the car department.

Equalizing Cut-offs in Walschaerts Valve Gears

By E. O. Waters, Instructor in Machine Design,
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It is a well-known fact among engine designers that the ordinary valve gear, consisting of eccentric, eccentric-rod, valve-rod and slide valve, does not give an equal steam distribution to both ends of the cylinder. If cut-offs are equal, admissions will be unequal; and if head-end release equals crank-end release, then head-end compression will occur earlier than crank-end compression. This is due partly to the angularity of the eccentric-rod, but principally to the angularity of the connecting-rod, on account of which the piston runs ahead from head-end to quarter, and runs behind an equal amount from quarter to crank-end.

The same irregularity is found in locomotive valve gears; and unless properly adjusted, it will cause unequal steam distribution to the two ends of the cylinders, as shown by actual indicator cards, and will result in undue vibration, uneven wear of parts, and liability to stall under heavy loads. The adjustment, which usually consists in equalizing the cut-offs for the running position of the reverse lever, should be made by the designer when laying out the gear on the drawing board. Methods of doing this, in the case of the Stephenson gear, have been outlined in several treatises on the subject; but, so far as the writer is aware, little or nothing has been published for the guidance of the designer of Walschaerts or other radial valve gears. In the article on "Walschaerts Valve Gear Design and Adjustment," by Mr. Lewis D. Freeman, which appeared in June, 1914, issue of the Railway Master Mechanic, a very detailed account was given of how to lay out the gear, without any attempt to equalize the cut-offs, it being stated that this could be done in the erecting shop when setting the valves, by lengthening or shortening the eccentric-rods a small amount to be determined by trial. But the effect of this is to disturb the equality of the leads and make the valve travel further on one side of the center than on the other; so that it would be better if the adjustment could be made on paper before the final center-to-center dimensions of the different links and rods are determined. With this in view, the following method has been worked out, after a careful study has been made from the theoretical standpoint and from a comparison of several drawings and prints of actual valve gears.

Suppose that the center lines of the main drivers and cylinders, the length of the main rods, the main crank and eccentric crank circles, the length of the eccentric rods, the length of the union-links and combination levers and the dimensions of the crosshead-arms (if there are any) are all known and laid off, to a scale of not less than 3 ins. to 1 ft., as shown in Fig. 1. Suppose further that the approximate length of the radius-rod is known, say within 5 ins. limits; and that the horizontal center line of the link is known, as well as the radius of the link-horn, so that the link center and the path of the link-horn may be drawn in a trial position, as shown by dotted lines in Fig. 1. Finally, let the lap and lead and maximum travel of the valve be known, so that a diagram may be constructed as in Fig. 2.

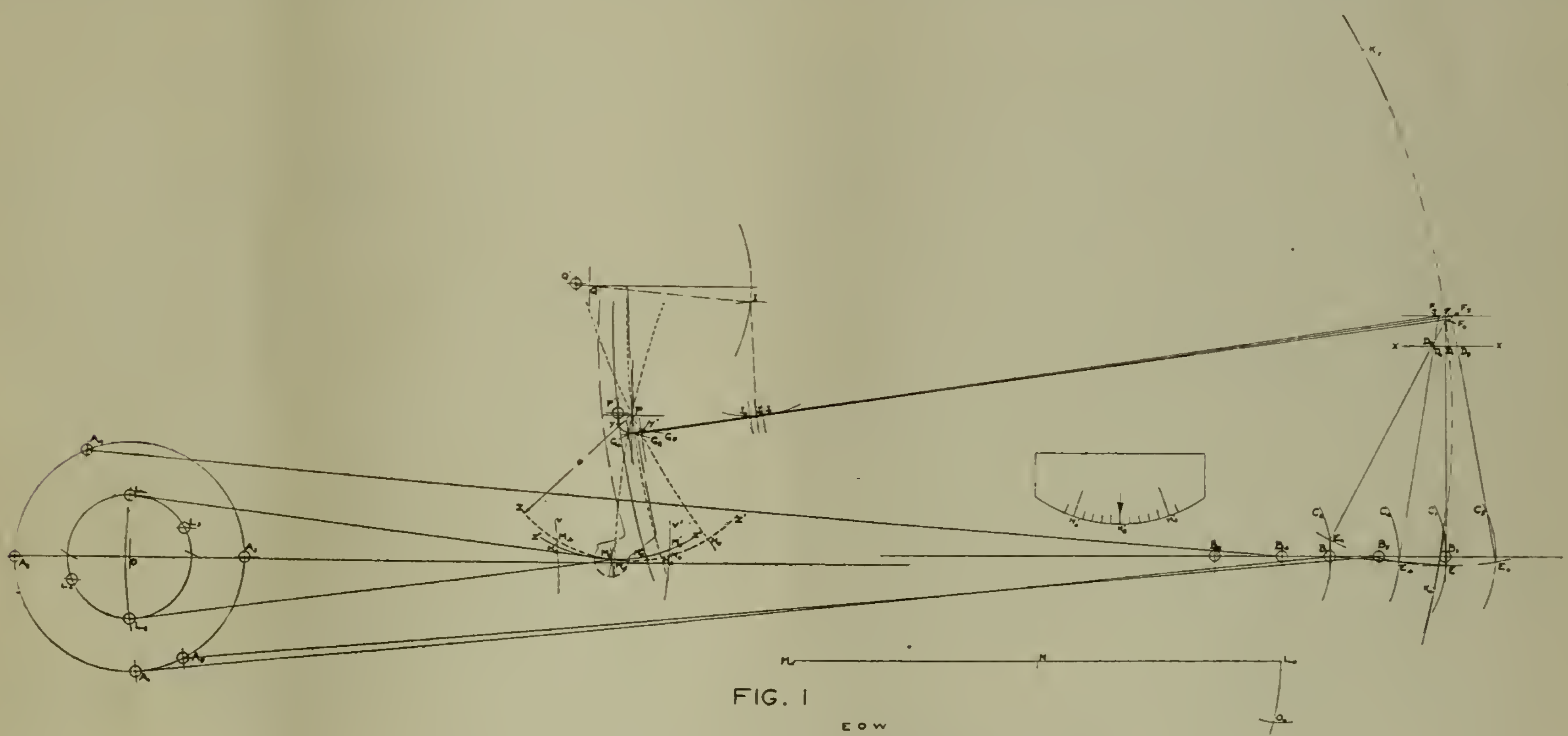


FIG. 1

E O W

General Layout of Walschaerts Locomotive Valve Gear.

The running cut-off must next be determined; this depends on the service for which the locomotive is designed, and may vary from 25 to 50 per cent. of the stroke. Let us assume that in the particular case under consideration it is 30 per cent. or, taking into account the fact that the piston rod reduces the effective piston area on one side, 29 per cent. head-end and 30 per cent. crank-end. The valve diagram. (Fig. 2) having been constructed for the maximum valve travel, the next step is to find the valve travel for 30 per cent. cut-off. To do this, mark off 30/100 of AB from A, and 30/100 of AB from B, and erect perpendiculars to K and L. Draw KL, and mark E, the point of intersection of KL with the lap circle. With any convenient radius, and C and E as centers, strike arcs intersecting at F and G; bisect CO and erect a perpendicular at the point of bisection. Mark the point H where this perpendicular cuts the line FG, and with H as a center and HO as a radius, describe a circle. If

the construction has been made accurately, this circle will pass through C and E, and will represent a valve movement in which the lead is CD, the travel is 2 MO, and cut-off occurs at 30 per cent. of the stroke, just as the circle OCK′ represents a valve movement in which the lead is CD, and the travel is 2 K′O, corresponding to the maximum valve travel for this particular gear. No proof of this is needed, the truth of the statement being evident to anyone who has had any experience with valve diagrams.

To complete the diagram, draw circle OJN equal to and directly opposite circle OCME, and mark points I and J where these circles cut the vertical line through O. The necessity of having these points will be shown later. Turning now to the valve gear layout (Fig. 1) proceed as follows: with center O and radius equal to the main rod length, mark point B_1 on the cylinder center line; lay a straight-edge on O and B_1 and mark points A_2 and A_3 where the straight-edge cuts the crank circle; then A_2 and A_3 are the back and front dead-points, respectively. With the same radius, and A_2 and A_3 as centers, mark the points B_2 and B_3 on the cylinder center line. Check by noting that $B_2B_1 = B_1B_3$, and B_2B_3 equals the stroke. Mark the crosshead positions for cut-off, B_4 and B_5, so that $B_2B_4 = 30/100$ of $B_2B_3 = 29/100$ of B_2B_3, and mark the corresponding crank positions A_4 and A_5.

With a radius equal to the length of the union link, and centers B_2, B_4, B_1, and B_5, strike arcs C_2, C_4, C_1, and C_5; it is evident that the point of connection between the union-link and the combination-lever must be somewhere on these arcs. (Note:—In many designs the union-link is attached to an arm which drops below the crosshead, instead of bolting directly to an extension of the wrist-pin as in the present example. In such cases, the centers of the arcs C_2, C_4, etc., would be the points of attachment of the union-link to the crosshead arm corresponding to the crosshead positions B_2, B_4, etc.) Draw the valve center line xx′ the correct distance above the cylinder center line; draw a horizontal line above xx′ the same distance away from it as the length of the upper section of the combination lever; and draw another horizontal line below xx′ the same distance away from it as the length of the lower section of the combination lever. The latter line intersects the arc C_1 at E_1, and the vertical line $F_1D_1E_1$, which should be drawn in, represents the middle position of the combination lever. On xx′ lay off D_2D_1 to the left of D_1 and equal to the sum of the valve lap and lead: and in addition lay off D_4D_1 and D_1D_5, each equal to the lap. Then with centers D_2, D_4, and D_5, and a radius equal to the lower section of the combination lever, or D_1E_1, strike arcs cutting C_2 at E_2, C_4 at E_4, and C_5 at E_5. Draw the lines D_2C_2, D_4C_4, and D_5C_5, and extend them each above xx′ to the points F_2, F_4, and F_5, so that the total length of each line equals the total center-to-center length of the combination lever. If the construction has been made accurately, F_4F_1 will equal F_1F_5, and F_2 will lie on the line F_1D_1.

The forward end of the radius-rod has now been located at F_4 and F_5 for the two cut-off positions and at F_2 for the two dead centers. The next step is to locate the rear end of the rod, and to do this it is first necessary to find out approximately what position the link-block should occupy in the link. This is given by the following formula:

$$r = \frac{s \cdot IJ \cdot FE}{t \cdot DE}.$$

r = radius of arc which represents the approximate motion of the link-block; s = radius of link-horn; IJ = distance IJ scaled off from the valve diagram, Fig. 2; FE = overall center-to-center length of combination lever; DE = length of lower section of combination lever; t = diameter of eccentric circle. All of these dimensions except r are known, and the center for r and s is taken at P, which is a trial position only, and may be 5 or 6 ins. away from the correct position of the link center.

Having computed r and chosen a location for P, draw arc yy′ with center P and radius r, and arc zz′ with radius s, and center P. With F_2 as center and PF_2 as radius, draw an arc cutting yy′ and G_2 and zz′ at H_2. This arc represents the link position for either dead center. With the same radius, but P as center, swing a long arc through F_2, as shown in Fig. 1. Draw G_2F_2 and assume that this is the dead-center position of the radius-rod, for a running cut-off of 30 per cent. If we assume that the bell crank dimensions and the length of the radius-rod hanger have already been determined, as is likely to be the case, together with the point of attachment of the hanger to the radius-rod, it is possible to find the position of the

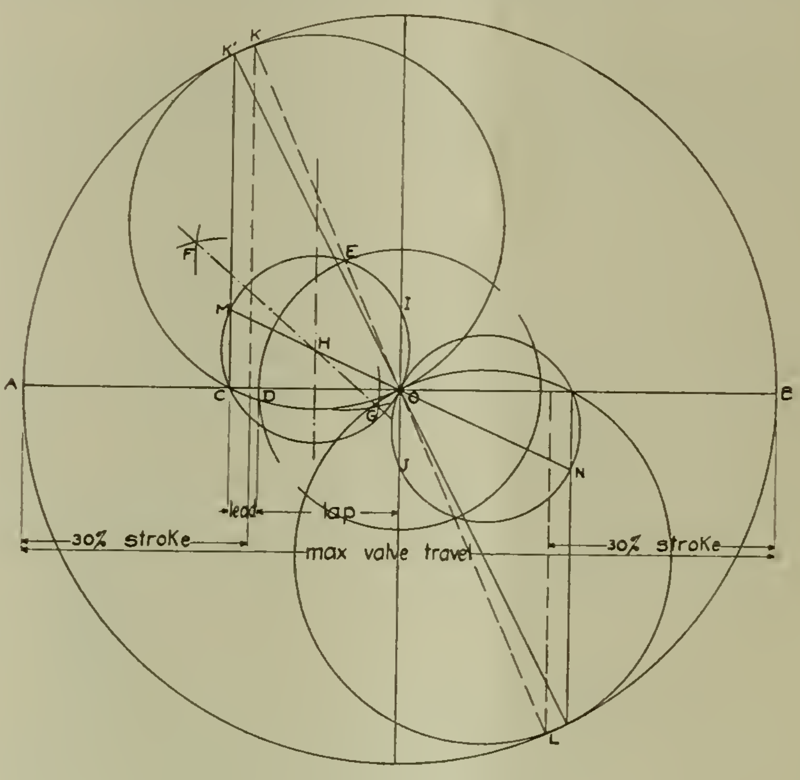


FIG. 2

E O W

Diagram of Walschaerts Valve Gear.

bell-crank and the hanger, corresponding to the position of the radius-rod G_2F_2; and this is indicated on Fig. 1 by Q, I, and J_2.

We now wish to find the link positions for head-end and crank-end cut-off, to find which proceed as follows: with center I, and radius IJ_2 draw an arc as shown; with centers F_4 and F_5 and radius F_2J_2 draw arcs intersecting the former arc at J_4 and J_5: with centers F_4 and F_5 and radius $G_2F_2 = PF_2$, draw short arcs near G_4 and G_5 as shown: then draw a line through J_4 and F_4 and continue to the left to the short arc near G_4, and a line through J_5 and F_5 and continue to the left to the short arc near G_5. These two lines represent the two cut-off positions of the radius-rod. Taking the left-hand end of each of these lines as centers and PF_2 as radius, swing arcs which will cut the long arc passing through F_2 at K_4 and K_5; then with the same radius, and K_4 and K_5 as centers, swing arcs passing through P and cutting arc zz′ at H_4 and H_5. These last two arcs, it is evident from the method of construction, will give the positions of the link-slot center line for the two cut-off positions of the engine.

The design of valve gear used here to illustrate the method which has been outlined in the preceding paragraphs, makes use of a hanger for supporting the radius-rod at its back end. Needless to say, the construction would be slightly different if a sliding-block suspension

had been used. However, the general method would be exactly the same, namely: (1) draw arc yy', (2) draw the radius rod in dead-center position, (3) locate the radius-rod suspension for the position given in No. 2, (4) draw the radius-rod in the two cut-off positions, (5) draw the link-slot center line in the two cut-off positions. It should be noted further that it is not necessary to obtain the radius r of arc yy' with great accuracy, as the final result of having this radius too large or too small would only be to bring H_4 and H_5 closer together or further apart, while the ratio H_4H_2/H_2H_5 remains almost exactly the same; and, as will be shown later, it is this ratio only that is of importance. However, too much emphasis cannot be placed on the care and accuracy with which the graphical work is done, as the result which is finally obtained depends on this to a very great extent.

The next step is to find the dead center and the cut-off positions of the eccentric rod. Locate M_2 on arc zz' so that $L_3M_2 = L_2M_2$ giving the eccentric-rod length, and L_2, O, and L_3 are on the same straight line. To do this, make the following auxiliary construction: draw L_aM_a equal to the eccentric-rod length; bisect L_aM_a at N; with radius NL_a and center N draw an arc, and with center L_a and radius equal to OL_2, cut the first arc at O_a: then with radius M_aO_a and center O cut the arc zz' at M_2. Check this location of M_2 by taking a radius equal to the eccentric-rod length and M_2 as a center, and swinging an arc to locate L_2 and L_3; then L_3, O, and L_2 should be on the same straight line. L_3M_2 and L_2M_2 are the dead center positions of the eccentric-rod.

Take a radius A_3L_3 (incidentally, this is the length of the eccentric-crank) and mark points L_4 and L_5 on the eccentric-circle, taking A_4 and A_5 as centers. Care must be taken to place L_4 and L_5 behind A_4 and A_5, the direction of rotation being considered as clockwise in Fig. 1. Then with a radius L_2M_2 and centers L_4 and L_5 swing arcs v and v', cutting zz' and M_4 and M_5.

If P has by chance been taken in the correct position, M_4M_2 will be equal to H_4H_2, and M_2M_5 will be equal to H_2H_5, since the motion of the forward end of the eccentric-rod and that of the link-horn must be identical. But, as a rule, this equality will not be found, and P must be located in a new position. This new position is found by making a template (shown in Fig. 1) having a curved edge with a radius equal to that of the arc zz', and with divisions on this edge marked H'_4, H'_2, and H'_5, corresponding to H_4, H_2, and H_5. $H'_4H'_2$ is divided into any convenient number of equal parts, say five, with one point outside H'_4, and $H'_2H'_5$ is divided into the same number of equal parts, with one point outside H'_5. The template is then placed with H'_2 directly over M_2, and is rotated about that point until the arcs v and v' intercept the same number of divisions (including fractional parts of a division) on each side of H'_2. When this position has been found, a line is traced around the edge of the template, giving an arc such as z"z"', with M'_4 and M'_5 as the cut-off positions of the eccentric-rod. If now we move the center of the link from P to P', the center of the new arc z"z"', and move the bell-crank center the same distance in the same direction, from Q to Q', the radius-rod will be changed so slightly that its position would be almost exactly the same as before, and the ratio H_4H_2/H_2H_5 would remain unchanged when the points H_4, H_2, and H_5 moved from the old arc zz' to the new arc z"z"'. Furthermore, the ratio H_4H_2/H_2H_5 equals the ratio $M'_4M_2/M_2M'_5$, and by very small changes in the radius of yy', H_4H_2 could be made equal to M'_4M_2, in which case H_2H_5 would be changed proportionally and would become equal to $M_2M'_5$. The arc through which the link swings from one cut-off position to the other would then be equal to the arc through which the forward end of the eccentric-rod swings from one cut-off position to the other; or, in other words, P' is the correct position of the link center for obtaining equal cut-offs at 30 per cent. of the stroke. With F_2 as center and radius $P'F_2$, swing an arc cutting z"z"' at H"2; then $M_2H''_2$ is the correct offset of the link-horn from the link-slot center line, measured on the chord of the link-horn arc z"z"'. This is illustrated by the dash lines which show the correct outline for the link.

Before settling finally on the point P' as link center, it would be well to locate the link center for equal cut-offs at some other percentage of the stroke, say 60 per cent., or else to see how much discrepancy between head-end and crank-end cut-offs there would be if P' were located as shown and the cut-off were lengthened to 50 or 60 per cent. For it must be remembered that, while equal cut-offs are desirable for the running position of the reverse lever, it will not do to have too much difference between head and crank ends when operating with late cut-off, or there will be trouble in starting or working up-grade under heavy loads. In such cases it may be best to find two or even three possible locations for P', and make the finally adopted position a compromise.

RAILROAD PLUSH

In former days the foreign plushes, especially the French plush, stood foremost as to manufacture and quality. It was almost exclusively used in this country for passenger coach seats, while American plush was regarded as unsuitable. In later years, however, American ingenuity has overcome all these former objections so that today plushes are produced here far and away superior to those manufactured in any other country. It is another example of what can be done when stern necessity demands action. We give some idea as to how this American plush is produced for the interest of those of our readers who like to learn something now and then about important railroad supplies.

Car seat plush is made of mohair (the hair of the Angora goat), which is imported from Turkey and South Africa, and is also produced in this country in large quantities, the principal states where the goats are raised being Texas, New Mexico, Arizona and Oregon.

The hair is first sorted as to fineness and quality into several different grades. These grades are then mixed and weighed out for manufacture according to the grades and quality of plush desired. After being mixed and weighed, the mohair is scoured and dried to cleanse it from dirt and grease, thus killing all germs. After cleansing, the hair is combed by machinery, the resulting product being Top, First and Second Noils, and Soft Waste. The noils and waste are used in the manufacture of carpets, robes, cloakings, etc. The top is next twisted or spun into yarn of the desired count (size), and then singed, that is, passed through a flame and the fuzz burned off to make it smooth.

Two warps are used in weaving, one of cotton or linen which forms the back, and the other mohair for the nap or pile. The mohair is woven in loops over wires, and is held down by the filling (cotton yarn running across the piece) by what is called the "W" weave. This is better than the "V" weave used in foreign plushes, as each tuft of the pile is held in place by a double grip. The wires are drawn in and out from the side of the loom and on the end of each wire is a sharp blade which cuts the loop as the wire is withdrawn. The plush as taken from the loom is a greyish color. It contains some dirt and grease and the pile has an uneven surface. It is thor-

oughly scoured, dyed the desired color, and the pile sheared down to an even surface.

Railroad plushes are made in 24 ins., 28 ins. and 30 ins. widths; the pieces run about 40 yards in length. No other material used for car upholstery gives as long service as mohair plush. There is a certain give to the pile which provides the passenger a firm, comfortable seat, so that he is not constantly slipping with the vibration of the car, and it does not wear out the clothing as does a smooth, hard-surfaced fabric. Plush is more readily renovated than other seats coverings, as it can be washed on the seat with soap and water, and brightened up by re-dyeing at very small expense.

COKE, COAL WASTAGE AND X-RAYS

By T. Osborne, Manchester, England

Some notes on the practice in relation to the supply and the treatment of coal on Indian railways may be instructive as well as interesting to readers. The problems discussed here relate to the screening of coal at the pits, the standard sizing of coal, regarding which no effective steps appear so far to have been taken to standardize the practice. Also the friability of different coals, their relative capacity to withstand transport and handling, and the permissible percentages of dust and small coal in consignments under delivery to ports or stations in different parts of the country. This latter question involves the standardization of screening tests and uniformity of practice with reference to the types of screens used, the kind of mesh, the size of the mesh, as well as the procedure in sampling. In connection with this series of problems also are being considered the question of the basis upon which penalties should be devised, not only for excess percentages of small coal and dust, but for the supply of inferior coal, or for coal containing quantities of stone or shale, or other impurities. There appears at present to be no guiding principle recognized when assessing penalties for such deficiencies; nor is there at present anything approaching uniformity of practice with regard to screening tests on the railways or elsewhere.

Another series of problems connected with this first group of questions, which claims attention is the development of the coking industry and on the selection of coals most suitable for railway requirements. In India the coking industry is at present somewhat backward. The quality of the coke that is produced is susceptible of improvement and its price is high. One of the defects of Indian coal is their excessive percentage of ash. Whether or not the bulk of this impurity is capable of elimination by washing the coal depends mainly upon the manner of distribution throughout the mass of the combustible part. A coal may be in other respects a good coking coal, suitable for railway work, but if the incombustible matter in its composition is distributed throughout the mass in a very finely divided condition, washing the pulverized coal has little or no effect. Such coal is, should the percentage of ash be high (as it is in all Indian coals as compared with most American and English coals) practically useless for coke. Desultory experiments have, it is true, been carried out by several companies, from time to time, wth the object of ascertaining whether or not better results could be obtained by washing previous coking. There is one rapid and unfailing system by means of which the desired information can be obtained, that is by the comparatively simple one of taking X-Ray photographs of the coal. The information obtained from such photographs will generally indicate at once whether or not further experiment has any chances of being fruitful or not. There is room here for much valuable research in the interests of railway enterprise.

The formation of an Indian Railway Coal Department has provided an instrument for maintaining the general quality of deliveries and for enabling the railways the better to select the fuel required for their own purposes, according to the conditions of each, yet the position as regards the actual effective utilization of fuels remains exactly where it always has been in India and where it still is in many cases abroad, but far behind the position attained towards the full problem by the most progressive administrations both in America and Europe; the points included are economical handling, proper firing and suitable treatment with reference to furnace and draught arrangements. The solution of the subtle and elusive problems of fuel wastage in the locomotive yards and on the locomotive itself, are left to the district officers to solve individually in India; there is no co-ordination of effort. In the pursuit of efficiency, experiments are being continually repeated on different engine runs, in different districts and on different Indian railways, from month to month and from year to year, and there is little or nothing as the result of it all, there is no material progress and there is a very considerable amount of wasted energy for want of co-ordination, and it should be added, for want of expert knowledge of the fuels being dealt with, which the recently established Indian Coal Department is now accumulating.

It has been suggested that the Coal Department cannot do much to assist railways, but for a proper appreciation of the best mode of dealing with any given description of coal, some knowledge of its chemical as well as of its physical characteristics is necessary. The district officer is far too busy with routine duties that must be done and with matters demanding immediate attention and decision in the regular course of railway operation, to be able to devote either regular or detailed attention to questions, which may indeed affect the amount of fuel consumed in his district, but will not make any difference to the

Lounging or Rest Coach on the Chicago & North Western Railway.

amount of the loads his engines can pull. Nor supposing that he can find time for experiments with his fuel, will he pass on his results to his neighbors. He and they will continue groping in the dark and repeating each other's failures, until measures are taken for enabling the results of such experiments wherever obtained, to be recorded, collated and analyzed with a view to future progress—not merely in individual districts, but on whole systems.

Some railway engineers have raised the point that Indian indifference in such matters reflects established practice as regards fuel consumption on other railways, but on a point of such great financial importance to railways as the fuel bill is, it is most desirable in the interests of the net profits, that pains should be taken thoroughly to investigate and to understand the methods of treatment best suited to different grades of coal. All the care taken in the selection of the coal may be thrown away, if the coal is not cared for properly by the operating staff on the railway; whilst, on the other hand, the best selection cannot be made with certainty without some knowledge of the arrangements that can be made in practice, in order to obtain the best effect from each of the coals from which the selection is to be made.

LOUNGING CARS.

By C. A. Cairns, G. P. & T. A., C. & N. W. Ry.

Buffet lounging cars now being placed in service on the Chicago & Northwestern Railway, and, in addition to operating in the Twin Cities Limited between Omaha and St. Paul-Minneapolis, this same type of car is now in service between Chicago and Duluth on the Duluth Su-

Interior of Smoking End of C. & N. W. Coach.

perior Limited and between Chicago and Minneapolis on the Chicago-Minneapolis Express.

This is a steel car divided into two sections, one of which is for the use of ladies and children and contains a large number of current periodicals and magazines. It is also equipped with a writing desk, stationery, etc. The other section is the observation end of the car and is for the use of men and women. Between these two sections is the compartment for the porter, and from which he serves a buffet lunch.

The work on these cars was done by the Pullman Company, and we are are able to show exterior and

Interior of Library End of C. & N. W. Car.

interior views of the cars. Mr. Robert Quayle is general superintendent of motive power and car department of this railway.

READY FOR THE CALL

Should the call to arms come and it might some day, with little warning, the Pennsylvania railroad is equipped to do its part in such an emergency, as many of the railroads in the country are. The great Pennsylvania system now has in service on its 11,000 miles of line and more than 26,000 miles of track, 7,500 locomotives with a combined tractive power of 250,000,000 pounds; 7,000 passenger coaches capable of carrying 330,000 people and 275,000 freight cars with a carrying capacity of 13,000,000 tons. The locomotives in the service of the Pennsylvania are capable of hauling at one time over any ordinary grades, 100,000 cars.

These trains could move, if required, an army of 5,000,000 to 6,000,000 men filling a line of track as long as the system's main track from New York to Washington and from Philadelphia to Chicago. Its vast shop accommodations are handled by 64,600 trained men. There are 700 civil engineers in the service and 200 mechanical and chemical engineers and its great army of employes number more than 200,000. The Pennsylvania serves 15 states whose aggregate population is 40,000,000 and it is estimated that in these states could be raised 8,000,000 able bodied soldiers. These figures have been prepared by Vice-President Dixon of the Pennsylvania and are of more than ordinary interest in these days, so full of talk on the subject of preparedness and what the United States is able to do in time of desolating war.

NOVEL SIDE ROD

The rear or carrying truck of the new Philadelphia & Reading engines reminds us of an occurrence of former days. It was some years ago that the carrying wheels of the 4-4-2 type of engines made their appearance. When they did, an assistant general manager of one of our large roads, who had a "mechanical turn of mind," completely ignoring the fire-box requirements, inquired of the superintendent of motive power, if it would not be possible to utilize these apparently useless wheels under the fire-box for tractive purposes. "Is there no way," he asked, "that you can connect them up?" "Well," replied the S. M. P., as a far-off and dreamy look came into his eyes, "there may be; but the only way I can think of just now is to use an india-rubber connecting rod."

ALTERNATING CURRENT AND PHASE

The expressions used at the head of this article are of frequent occurrence in books on electricity, and they are entering more and more into the language of the railroad world.

In 1831 Michael Faraday discovered that currents of electricity can be induced in a closed circuit of wire by moving a permanent magnet near it, or by moving the wire circuit across the magnetic field. The current set up by this motion of wire or of magnet is called an induction current, because it is induced by the appropriate motion. This discovery is the principle of the modern dynamo. An electro-magnet acts in the same way.

When Faraday placed a magnet on the table and brought a closed wire circuit toward it, a current of electricity flowed through the wire in one direction. When the motion of the wire stopped, the current ceased. When the wire was drawn away from the magnet, the flow of current in the wire started again, but in the reverse direction to the first flow. Here, then, was the alternating current. Electric currents are alternating unless purposely changed by a rotating machine called a generator. This is true as far as generated currents are concerned.

The ways in which this principle is made use of are various, but in the simplest form we may picture the operation something like this: Suppose a permanent magnet, or a small electromagnet for that matter, be held so that the open ends are free. Take a closed wire circuit long and thin, like a violin bow, with the wires separate throughout their length, but joined at the ends like the back and cat-gut elements of the fiddle bow. Adjust this circuit so that one end is just allowed to move through the free ends of the magnet, and put the other end of the circuit on a horizontal shaft, and then turn the shaft. At each revolution the end of the "fiddle-bow" wire circuit, remote from the handle end, sweeps round and cuts through between the free ends of the magnet. In this operation it must be remembered that the "fiddle-bow" wire lies so that "back" and "cat-gut" sides are horizontal, just as if laid on the table. Now, as this circuit approaches the ends of the magnet a current begins to flow, say down the "back" and up the "cat-gut." This current begins about a quarter of a turn before coming to the poles reaches its maximum when passing the ends or poles of the magnet, and dies away to nothing at a quarter turn past the poles.

This down-back, up-cat-gut current has, therefore, occupied half a revolution waxing and waning. The other half of the revolution is occupied by a reverse current. This is a down-cat-gut, up-back flow, which waxes and wanes like the first, but has its maximum when the end of the "fiddle-bow" circuit is farthest away from the magnet. With suitable collector ring at the shaft where the handle of the "fiddle-bow" is attached, an alternating current flows out on the main line, which is attached to the collector ring.

So far we have represented the alternating circuit in a crude though substantially true way. It is manifest that a machine such as we have described would be wasteful, or, rather, it could be made to do a great deal more with the same expenditure of power. Let us suppose that we use more permanent magnets—say, four in all. The arrangements of the four separate magnets must be made in accordance with the principle discovered by Faraday.

When the first induced current begins to die down and the second reverse one comes on, the next magnet must be arranged so as to augment the reverse current and not destroy it. The poles must be arranged north pole, south pole; south pole, north pole, etc. As the closed wire circuit sweeps round between the first, north-to-the-right magnet pole, the induced current takes a down-back, up-cat-gut course. The reverse current takes the down-cat-gut, up-back direction, and this is the natural way it would flow if the second north pole was to the left, as it is. The reverse current, following the effect produced by the first magnet, is strengthened by being joined in with the initial current of the second magnet, and its after effect, if we may so call the reverse current of the second magnet, coincides with the initial current set up by the third magnet, and its reverse current coalesces with the initial current of the fourth magnet. The poles stand north right north left north right north left and so on.

All through we have the initial induced current of one magnet augmented by the reverse current of the previously encountered magnet. The collector rings on the shaft

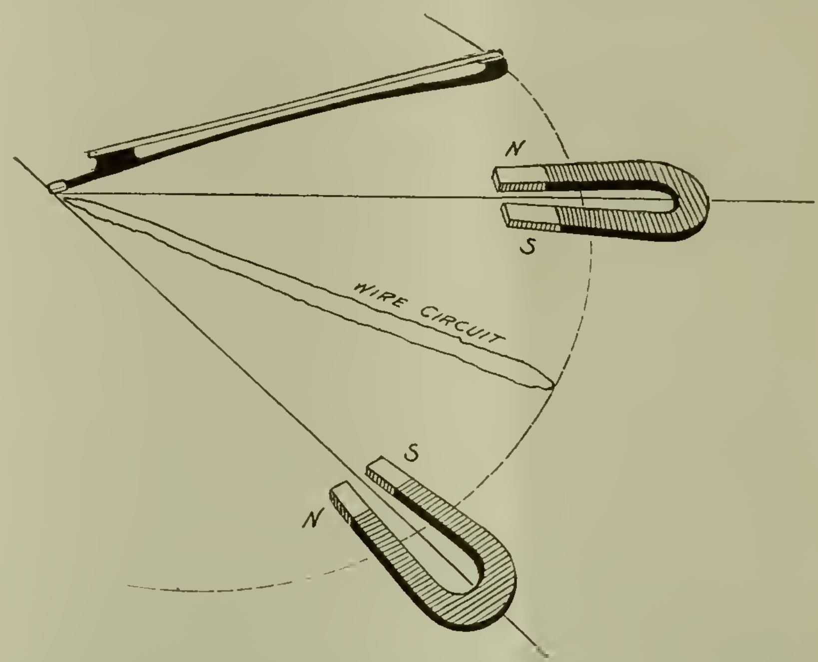


Diagram Showing Elementary Principle of Alternating Electric Current.

take up the induced currents and pour them out with great velocity along the surface of the main electric wire of the system. This is all true with a few separate permanent magnets, but is different where electro-magnets in a regular machine are tied in together with wire wound from one pole to another. The winding changes the polarity of the parts.

Electricity travels with the speed of light, 186,000 miles a second, making any necessary deduction for the resistance of wire, air, water or other medium, this almost incredible velocity, which would girdle the globe more than seven times in a second, is practically instantaneous for any terrestrial distance.

When we come to what electricians call "phase," we have to take into consideration forms of construction and effect much more complicated than those we have been describing, because armature windings of various kinds have to be taken notice of. Phase, however, may be simply defined as a difference in "position" of current or electro-motive force (E.M.F.). Phase difference is expressed in degrees of a circle. If two currents differ in phase by 180 degs., or half a cycle, they will be in direct opposition to each other. Here a complete cycle is 360 degs.

The time required for an alternating current to complete one cycle—that is, to flow in and flow back along a wire—is called a period, and the number of cycles per second is the frequency of the current. An alternating current flows back and forth as regularly as the motion of the piston in the cylinder of a locomotive; but, of course, the electrical impulse travels with an exceedingly high velocity. An incandescent lamp illuminated

by an alternating current with, say, a frequency of 60, actually glows and goes out 60 times each second. The persistency of vision is from 1-10 to 1-7 of a second, and as the lamp lights and goes out every 1-60th of a second, the eye does not detect the alternations, and as the filament does not have time to become cool or cease to glow in that brief period, the light appears to be continuous.

Three-phase alternating machines, such as Mr. Reginald Gordon refers to in his article on "Electrification on the Norfolk & Western," have three sets of coils. The coils of each set are 120 degs., or 1-3 of a circle, apart, and there may be any even number of poles. There is a continuous winding around the whole frame of the machine, all connected together and so grouped as to form poles. These poles are not stationary, electrically, but revolve electrically, that is, the invisible electro-magnetic field revolves, depending on the frequency of the supply and the number of groups or poles. If arranged at an agle of 120 degs., it gives a three-phase alternating dynamo or motor, as the case may be.

PERFORMANCE OF P.R.R. ELECTRIC LOCOMOTIVES.

Some interesting figures have just been given out covering the electric locomotives used by the Pennsylvania Railroad on the Manhattan Division, operating passenger trains through the tunnels entering New York City under the Hudson River. These locomotives have been in use for nearly four and one-half years, and the data given below represents their performance during the period in a very striking manner. They were designed to start and accelerate a 550-ton train, in addition to the locomotive, on a 1.93 per cent. grade in tunnels, but in actual operation 850-ton trains are frequently started on this grade and trains of 14 all-steel cars, weighing over 1,000 tons, are handled without difficulty.

Each locomotive in service passes over an inspection pit every 24 hours, when running inspection of machinery is made, similar to that given steam locomotives over the pit, and slight repairs made where necessary. The average time required for this inspection is approximately ten minutes. After 3,000 miles run, the locomotives are taken into the shop for a general or periodic inspection, when all electrical apparatus is thoroughly gone over, tested, cleaned and necessary adjustments and renewals made to all electrical and mechanical parts. The shopping of these locomotives for general repairs is governed by tire wear, and a number of locomotives have run from 90,000 to 112,000 miles before it is necessary to turn the tires or do any general repair work.

The general overhauling and repairing of these locomotives is done in one of the regular steam locomotive repair shops.

On November 28, 1914, these 33 locomotives had completed four years' service. During this period 463,558 train movements were made, or an average of 1,300 movements for a detention, due to engine failures.

At Manhattan Transfer, where the change is made from steam to electric locomotive, on trains to and from the Pennsylvania station, the time allowed per schedule for making change, including necessary testing of air brakes, is four minutes; although the entire operation can be performed in three minutes, and has been done in two minutes.

These locomotives are articulated machines, each consisting of two semi-units permanently coupled together, each semi-unit having a four-wheel bogie-truck and two pairs of driving wheels connected by side-rods, the semi-units being permanently coupled together at the driving wheel end. The locomotive frames, driving wheels, trucks and running gear are similar in general character to the standard American type steam locomotive and the relation of the various working parts on the two semi-units is similar in location to two steam locomotives coupled back to back.

Each semi-unit is equipped with 2000-horsepower motor connected to the driving wheels through a system of parallel rods and cranks with an intermediate shaft, and is fitted with unit switches, master controller, automatic and straight air-brake apparatus, electric headlight, pneumatically operated whistle, sand apparatus. The locomotive equipment is so arranged that in the event of one motor being cut out of service, the entire locomotive can be operated from the other cab with the remaining motor. The unit switch control permits two or more locomotives to be coupled and all to be operated from either end of any one cab. The semi-units are interchangeable, and if any semi-units are separated, they can be combined with any two other semi-units, as may be required in making repairs, or for other reasons. The controllers

Pennsylvania Railroad Electric Locomotives Operated as One.

are fitted with four running notches, giving a variety of speed regulation.

The motors are of the direct-current, field-controlled commutating-pole series type. The weight of each motor complete, including cranks, is 43,000 lbs. The motors are supplied with direct current at 650 volts from the third rail, through contact shoes, on either side. The rated tractive power of each locomotive is 66,000 lbs., but in actual service 79,200 lbs. has been registered.

AUTOMATIC LOCOMOTIVE STOKERS.

When the automatic stoker was first introduced on the locomotive many persons regarded it as a coal saver and contrasted its work with that of a good fireman. As a matter of fact, the prime object in the use of a mechanical stoker is not to excell a good fireman or to save coal. The stoker does good work if it equals a good fireman, and incidentally saves coal.

In some quarters it was feared that the introduction of the mechanical stoker would mean the elimination of the fireman, but later it was found that a stoker did not retire this worker. If, then, the stoker does not take the place of a good man, nor does it do very much better than good, intelligent firing, and that its prime object was not to make a record as a coal saver, it may be asked what is it intended for, and why is there so much activity on the part of the stoker people?

In the first place, the original intention in getting up the stoker was to provide means to mechanically exceed the endurance of the fireman and to go on with the heavy work of firing where a human fireman would become exhausted. It reduced two firemen to one, but exceeding human endurance has now been accomplished by mechanical means. It is one of the few and curious instances where a mechanical contrivance was not expected to take charge of things generally when the operator failed mentally, and where for the moment his judgment was at fault.

The mechanical efficiency of the stoker was originally directed to supersede the purely physical endurance of the man. When the stoker was devised it was found that it could be used with great nicety in handling different grades of coal, and when the adjustment was made with care the results showed that it could be regulated so as to save coal. The fact that the fire-door did not have to be opened with the mechanical stoker was found to be most beneficial.

At the present time there are nine kinds of stokers, and, according to the committee report to the M. M. Association, of which Mr. A. Kearney, S. M. P. of the Norfolk & Western, was chairman, they are as follows: The Crawford stoker is of the underfeed type; the Street, Hanna, Standard and Kincaid are of the overfeed or scatter type, and the Ayres is the exponent of the chain-grate type.

The Crawford Stoker (underfeed).—At the present time there are 282 Crawford double underfeed stokers in operation on the Pennsylvania Lines West of Pittsburgh. The stoker is still the only underfeed type in service. However, it has been claimed that the Raite stoker, while it has never been tried out, can be operated as either an underfeed or an overfeed type. In addition to the 282 Crawford stokers in service on the Pennsylvania Lines, the following are also in use, being tried out experimentally: Two on the Bessemer & Lake Erie; four on the Vandalia; three on the Pennsylvania Lines East of Pittsburgh. This makes a total of 291 in service. It is reported that a new pattern of the Crawford stoker, known as type "30," is being constructed for test. The above figures show somewhat fewer applications than previously reported, but it is due to the retirement of a number of the earlier designs. While there are not as many in operation as a year ago, progress continues, and with the advent of the new design it is probable a number will be applied in the near future.

The Street Stoker (overfeed, or scatter type).—The Street stoker (one of the first, if not the first, to demonstrate its capacity to deliver fuel at a rate in sufficient quantity and regulation to maintain satisfactory steam pressure) still shows the largest number in service, totaling 531, with twenty-four on order, as in their statement. The type "C" stoker, which is the latest design, has a variable-speed engine and a friction clutch, instead of differential gear that was employed in the earlier type machines. The type "A" machine carried a crusher on the tank, but in the latter design the crusher was set aside, the conviction being it was better under certain conditions to supply the fuel that would pass through the 2½-inch mesh on the locomotive tender. These stokers are in operation on fifteen railroads. However, from the tabulation showing the distribution of the stokers, it can be seen that most of them are found on Eastern

Pennsylvania Electrically Propelled Train Leaving New York Terminal.

roads, the B. & O., N. & W. and C. & O. having 80 per cent of the total number in operation. The Street stokers are operated in passenger, general fast and slow freight service, performing their work satisfactorily. The machines have done remarkable work, on account of their durability, and nothing more is needed in their favor than their record and applications made. The principle upon which the machine is designed and operates is very widely known.

The Hanna Stoker (overfeed, or scatter type).—The Hanna stoker is equipped with durable crushing facilities on the tank, consisting of a heavy helicoid conveyer screw and a bulkhead containing a restricted opening, partly encircled by two stationary knives. Coal is forced through the restricted opening in the bulkhead by the revolving screw, assisted by the two stationary knives for breaking the larger lumps. This stoker handles slack as well as run-of-mine coal quite efficiently, regardless of weather conditions and moisture of fuel. In the past year eighteen Hannas have been in continuous operation on sixteen Mallet engines, one Mastodon and one passenger engine. Up to the present time there has been no report showing the stoker has failed to supply steam under the severest conditions, when properly operated. In the event of one of the stokers breaking down, it does not necessarily mean a failure, as the stoker is provided with two distinct resources to be utilized in such emergencies: first, if any part of the tender conveyor becomes inoperative, the conveyor can be thrown out of operation by means of a clutch and the coal can be shoveled into the locomotive hopper through an opening in the deck; secondly, if the entire stoker becomes inoperative, coal can be shoveled to the plate by hand, from which it is driven to any section of the firebox by means of a blasting chamber and distributing plate. With the assistance of the distributing wings, which is a feature of the machine, the use of the fire hook is materially decreased.

The Standard Stoker (overfeed).—The Standard stoker is equipped with adequate crushing facilities on the tank, consisting of a durable helicoid conveyor screw and a bulkhead having a restricted opening partly surrounded by fixed center-punches. Coal is forced through the opening in the bulkhead by the revolving conveyor screw, assisted by the stationary center-punches for crushing the larger lumps. The apparatus is so constructed that it will handle moist coal quite satisfactorily. As has been previously explained, the stoker is placed under the deck of the engine, leaving the deck and boiler-head clear. The machine makes very little noise in its operation, has a good distributing feature, and is very simple in its control. The latest development of the stoker is the type "AB," which we understand possesses a number of distinct improvements over the type "A."

Gee Stoker (overfeed, or scatter type).—The Gee stoker continues in service on a consolidation locomotive on the Pennsylvania Lines East of Pittsburgh. It is reported that the stoker was put in operation December, 1912, and that it operates satisfactorily. However, it is still undergoing development. Recently slight changes have been made in the control and distributing features.

The Kincaid Stoker (overfeed, or scatter type).—The Kincaid stoker, which for the past year has been under development on a C. & O. yard engine, continues to progress. The distributing features of this stoker are attached to the fire door. Coal is shoveled into a hopper elevated in front of and attached to the door, from which it gravitates to a distributing apparatus and is delivered to the firebox. It is reported that a conveyor has been worked out and has been applied. After this is done it will be given a service trial on a freight locomotive on the same road.

The Elvin Stoker (overfeed, or shovel type).—The Elvin stoker is of rather novel construction, and is the only one that has not substituted some other device or devices for the scoop. Its construction and principle of operation were explained in the committee's last report. A number of stationary tests have been made with the stoker, and it is thought that within the near future the machine will be tested out on a locomotive.

The Raite Stoker (underfeed or overfeed).—The Raite stoker, claimed by the inventor to be either an underfeed or a scatter type, is the only one which the committee has any knowledge of that embodies a combination of the two methods. Mr. George B. Raite, of Indianapolis, advises that this stoker is still being developed and will soon be ready for application. The inventor further claims that special features were recently worked out which should materially improve the distribution of coal and aid combustion.

The Ayers Stoker (chain grate).—The Ayres stoker, the sole member of the traveling-grate-type family, reports progress. Last summer and fall a number of experimental trips were made with this stoker as applied to a N. Y. C. engine, the results of which are reported to be encouraging. During the past winter the stoker has been further developed, and it is thought that it will soon again be ready for service.

Locomotive stoker patents have been issued to Messrs. G. De Grahl, R. S. Riley, W. R. Wood, C. D. Young, N. E. Gee, A. G. Elvin, W. C. A. Henry, D. F. Crawford, C. F. Street, W. T. Williams, H. L. Williams, F. S. Forsdick, F. M. Underwood and P. M. Thayer.

NEW COURSES AT WENTWORTH INSTITUTE

The Wentworth Institute of Boston have recently added two new courses. The first is a one-year day trade course in forging, hardening and tempering. This course is intended to give training to young men who wish a thorough knowledge of both hand and machine forging in wrought iron and steel. The second new course is a one-year day trade preparatory course, intended for young men who wish to enter some one of the manufacturing industries, but who require a year in which to discover in what direction they are likely to show special skill or ability. Next year, for the first time, the second year course will be in architectural construction. This course is for training building superintendents, specification men, and constructionists for architects and building contractors. Only those engaged in the building trades realize how modern fireproof steel and cement construction has created a demand for men trained in these branches. This new course of instruction is intended to meet such a demand.

INFORMATION ABOUT FOREIGN TRADE

In order that American business men may be able to procure condensed, authoritative information with respect to the way in which the European nations carry on trade campaigns and organize their commercial activities at home, the Bureau of Foreign and Domestic Commerce, Department of Commerce, has been issuing pamphlet presentations of the subject, covering several of the leading European countries. Monographs on the methods adopted by these countries have already appeared, and one on Switzerland is the latest to come from the press. This little book is entitled "Commercial Organizations in Switzerland." It reviews the history of the chambers of commerce and trade, explains the independent and official types of organizations, and their functions.

With Brain and Hand

By A. O. Brookside

Talk about being busy, you ought to see the signalmen in the "A" box at Griphin Street, at the outer end of Waterloo station in London. Upwards of 180 levers are controlled by these men, and the operation of the levers sets the switch-points and the signals that govern them. There are over two thousand locomotive movements in the twenty-four hours, and each movement involves the use of two or more levers, so the men are not idle. The whole system is so arranged that conflicting routes cannot be "cleared" at the same time, but it requires good judgment, a quick eye and a clear head not to "tie up" traffic. These men, like many other railway employes, work with brain and hand.

Interior of the "A" Signal Box at Griffin Street, London.

As I stood on the platform one morning early in October wating for the inspector who was to take me for a "spin" down the line to the L. & S. W. Railway locomotive shops at Eastleigh, I had an opportunity to look at the "iron horse" that I was to ride on, in its business suit of shining brass and bright green. It was what they call a four-coupled bogie engine, meaning by that, four driving wheels connected, and a four-wheel truck in front. On the driver's side, for so they call the engineman in England, there was, fastened to the front buffer beam of the engine, a white disc, about 14 ins. in diameter, which indicated that the "8:57 A. M. ex. Waterloo" was bound for Southampton, and like the signet ring of Fitz-James in Sterling Castle, "each guard and usher knows the sign." In other words, the white disc was our identification to all the signalmen along the line, that they might know us, and accord us our rights of time and track, so that we might cover the first stretch from London to Winchester in one steady non-stop run.

The firebox of this locomotive had a grate area of 24 sq. ft., that is about the size of a modest dining room table, say, 4 ft. wide and 6 ft. long, around which perhaps eight persons could conveniently dine. Although the locomotive grate was not exactly in dining table form, it ate up the speed-sustaining fuel with a ravenous appetite, and boiled water at the rate of a bath-tub full every few minutes. The firebox and the flues, through which pass the hot gases from the fire, form the heating surface. If all the firebox plates, ends, sides and top were laid out together, and the flues split open and hammered flat, one would have a good idea of the area against which the flame and the hot gases beat, under the stimulus of the forced draught. As a comparison, one may say, on a cricket field the bowling crease is 8 ft. 8ins. wide, and the wickets are 66 ft. apart. The area contained between these boundaries equals 572 sq. ft. The heating surface of this locomotive, if laid out flat, would equal more than two and a half times such an area. The 24 sq. ft. dining table of this locomotive had to supply all this surface with heat enough to maintain 175 lbs. steam pressure against the heavy drain put upon it by this racehorse of the iron way.

Now the inspector has come, and we step on the footplate, and I take a quick glance at the levers and gauges and valves. On signal from the guard we are off. The reverse lever is full ahead and the double handled regulator is moved so as to admit steam to the cylinders. It is an easy start and we glide out from under the arching roof of Waterloo, past the wonderful "A" box and out into the fog—the famous London fog. It all looks like Turner's picture of "steam and fog and stream," in the Tait gallery. The tracks on either hand appear to be full of moving trains, shunters and roadsters, goods and

London and South Western Passenger 4-4-0 Locomotive.

passenger, paying no attention to us—and we are the "8:57 down, ex. Waterloo." Fog at Vauxhall, fog at "Loco. Jct.," fog at Nine Elms, and on through Clapham Junction, our white disc in front, telling our story, so that points and signals are set Southampton-way, and on we go. Nothing is said, the "driver" looks ahead through his bull's eye cab window, and the stoker's long-nosed shovel rings clear on the flange of the firehole rim.

Earlsfield shows a few tennis nets slack and wet with the heavy fog, then we rush under the overhead pathways at Wimbledon. There is little clearance for the "chimney" and the steam and smoke flatten out against these, like a vaporous umbrella that gets blown inside out by the sweep of the carriages behind. Raynes Park gives a choice of route to Epsom, but our white disc says "Southampton" to the quickly answering signals, and on we go. Coombe and Malden fly by and the station at Surbiton seems to rush at us out of the fog. As we pass, men on the platform gaze at us with wide open eyes, with even a trace of apprehension in the look. Yet out of all reason and logic, it is always those in safety on the ground that wear an anxious look, while we, rushing past, hurled along by the power of steam and moving steel, facing danger we heed not, glance at our fellows on the earth with a serene and calm expression, if not one of actual superiority.

Leaving Surbiton, the "driver" makes a note in his book, the pencil trembling with the motion of the machine, he writes with deliberation a word or two by Esher and a couple more at Clermont and a final figure opposite a clump of trees where Welton can be seen on a clear day. At Weybridge we swing round a long, easy curve, with the slight tilt to one side which the elevation of the outer rail gives us, and look down on the similar but exaggerated slope of the cone-shaped banking for motor cars on the Weybridge track. Then Byfleet goes past, and the inspector dodging the deftly-swung coal shovel comes over to me and says, with a smile, "Here is Woking Junction, where the company takes care of "young" railway men," and almost at once the L. & S. W. orphanage glides past.

The engine rides very smoothly, notwithstanding that it weighs 86 tons, 16 cwt., which to us, from the American side of the water, is a comparatively light machine, and the small cab and the inside cylinders look somewhat strange. Brookwood cemetery shows up gray and still as we thunder by, our plume of white steam tossed high from the "chimney," but beaten down by the rush of air that our own motion causes to sweep over us in our flight. As we approach Farnborough the high dome over the last resting place of Napoleon III and the Prince Imperial, can be seen through the trees on the "driver's" side, which position for the engineman, unlike our practice here, is on the left. The "driver," however, is unmindful of the "highty dead," and with alert eye on the signals head, has shut off steam, and dropped down the reverse lever, and has his hand on the vacuum brake. Our speed slackens, and we have made what is officially known as a "slow down." A train ahead is leaving the main line for Aldershot, and "the signals are against us," as the men say, but the signals preserve the regular spacing of the trains. There also is a branch line for Ascot, and as soon as the train ahead has cleared our line, "several huge wooden razors shave the air," as Dickens says in "Barbox Brothers," and we are pushing on again although the slow down has cost us several minutes and some miles.

Fast "Up" Passenger Train, 4-6-0 Engine, with Rear of "Our" Train on the Left.

Tracks at Clapham Junction of L. & S. W.

With Farnborough behind us, the line is about 200 ft. above the sea level. It has been more or less of a steady climb from London. The track from Woking to Basingstoke is practically a level road with few curves, making what may be called a speedway 22 miles long where spurts of fast time are made. Many of the express trains do it regularly in 20 minutes. The "driver" now fully opens up the throttle valve, and the stoker takes a look at the steam gauge and our speed begins to increase.

The driving wheels are 6 ft. 7 ins. in diameter and therefore turn 255 times in 1 mile, so that passing Winchfield and Hook at full speed, we spin our wheels round a little more than 2,800 times in 11 minutes, until Basingstoke is reached. Just before coming to the station we pass the up express from Exeter, pulled by one of the late Dougall Drummond's newest 4-6-0 engines, high shouldered, powerful and swift. A trail of light smoke, the gleam of steel and the flash of glass, a brief roar and hum, and she is a mile away toward London.

Now we find ourselves racing on through a deep cutting with high white sides of chalk. At the end of the cutting there is a tunnel. It looks as if the locomotive and train would never go through, for the near portal, though yawning wide, seems yet too small, while the far one is but a bead of light, with rails lost in the intervening gloom. The metals lead to the tunnel and there is no escape. I can just see through the tunnel the form of what looks like a tiny locomotive approaching us on the up line. We enter first, and the curved roof above us catches our steam and smoke and whirles it down over the up line for the passing train to tear apart. On she comes, the glare from the firebox illuminating the clouds of steam that fill the space behind her and in front of us. We pass in mid-tunnel with a whistling of hot air in the mad rush and we drive on in momentary darkness, sucking up the wisps of vapor left by the up express, as we hurl them out into the light of day. A steep chalk cut, wide and high, is what we rush through before Cuddeston Junction is reached, and it is as we near the end of the cut that the white disc on the buffer beam indicates that we must now leave the main line and turn off for Micheldever. Passing it, we are again at the bottom of a deep ravine-like cut amid the "chalk hills of Hampshire," and running for the west portal of a tunnel that looks like a faint horseshoe of light with a mountain of earth above.

Travelers in the carriages often notice the whitening effect of vapor on the window panes when a train is passing through a tunnel, but the cause is clearly and strikingly presented to one riding on the locomotive. The smoke and steam shot upward from the "chimney," struck the curved roof of the tunnel over to one side of the center, for the down line is at the left. The overhead clearance is small and most of the vapor strikes down along the sloping roof and sides, and so practically envelopes the carriages.

Winchester is now in sight, the engine and train has run through the chalk tunnels after Micheldever, with a bright fire and damper adjusted to prevent smoke. The throttle lever is moved "home," the beating of the exhausts cease, while the safety valves buzz furiously. A shrill sound comes from our whistle, the reverse lever is dropped full ahead and the vacuum brake hums under the touch of the driver's hand. The whirling wheels below us slow their speed, then another application of the brake and one may see the spokes. The brakes grip again and we are at Winchester, 66½ miles from London, with one "slow down" and a fine burst of speed between Woking and Basingstoke to our credit; that gives us an average of 55 miles an hour. We have hardly a minute at the ancient "White City" of Britain, and are off again while I catch one glimps of the square towered old cathedral. We move out of Winchester without sound of whistle or stroke of bell. By the time we reach St. Cross' signal box, a mile or so further on, we are gathering speed, and with driving wheels measuring off 20 ft. 8 ins. of rail at every turn we have no time to take the dole of ale and bread for travelers from the Beadsmen of Holy Cross. Shawford and Twyford fly by, and the signals at Eastleigh stand out clear, protecting the diverging lines to Fareham, Portsmouth and Stokes Bay. At last we halt at Eastleigh, where the South-Western locomotive shops are situated. I stepped down with the inspector and bade good-bye to "driver" and "stoker." Dickens' "wooden razors" again shaved the air and the locomotive moved off with its line of carriages behind, filled with men and women who have trusted their lives to the pointsmen in the signal boxes who read "Southampton" from the white disc, and to the "driver" who regulates the power and measures the speed of the machine of brass and steel, and who picks out the signals by day and the twinkling lights at night, as he stands in all weathers, working with brain and hand, on the footplate of the fast express, where the miles of distance are cast behind him, and time is given to him only as the second-hand ticks on the face of his watch.

THE PANAMA CANAL

Whether the Panama Canal will develop into a violent competitor of the transcontinental railways or not is a matter of no interest at the moment apparently, for this new waterway is now tied up absolutely by the tremendous slides which have recently taken place in the Culebra cut. It looks amazingly as though this thoroughfare would be out of commission for some months. The slipping or sliding of vast quantities of material into the canal has taken place on both sides, leaving a width in places of only 25 ft. and a depth of less than 15 ft. As fast as these accumulations of mud have been dredged out they have been promptly replaced by other slides, until it would seem like a hopeless task to overcome the blockade.

Much engineering skill will have to be exercised before this serious trouble can be effectually and permanently vanquished. The railways can, just now at least, enjoy a laughing spell at the expense of the government, and go about their business without being burdened with the dire possibility of competition which has developed into a glaring bugbear since the canal began operations as a public highway.

A TRAIN OF WOES.

The national railways of Mexico have indeed suffered seriously the past several years on account of the incessant turmoils in that country. The management of these lines has not even been able to keep its accounts properly because the military forces seized and carried away many of the books and other documents upon which the different departments depended. Even office furniture in large quantities was appropriated by the soldiers.

But the greatest misfortunes lay in the overwhelming loss in traffic during this period of revolution and disorder. Gross earnings for the year ended June 30 last were $1,776,981 as against $34,273,341 in 1914 and $57,645,990 in 1913, and $61,447,790 in 1912. The profit and loss account shows a deficit of $57,645,990 as against a surplus of $98,932 in the preceding year. Efforts are now being made to put all the national lines in good condition once more. The devastation due to war can seldom be considered intelligently until a war is over and Mexico, in a way, is an example of the awful effects of such direful calamities.

An Impressive Anniversary

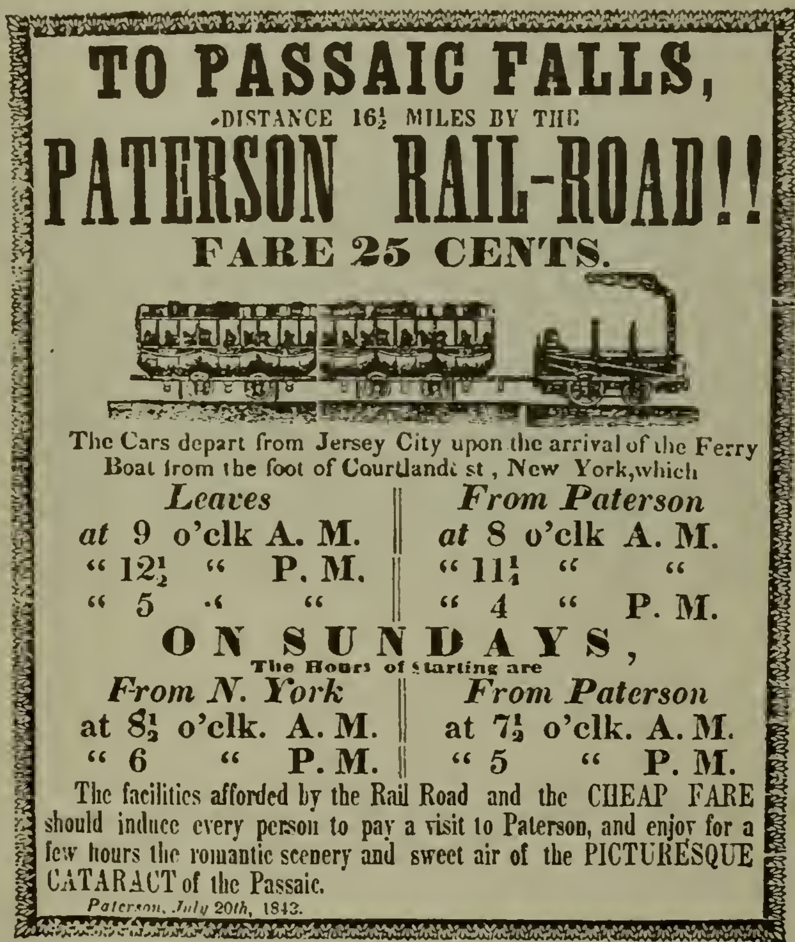
The Erie Railroad Company owns, controls, or operates, under lease, 3,686 miles of track—equal to the distance between New York and San Francisco. It has expended during the past fourteen years for betterments alone, $100,000,000 and over its magnificent system now linking Chicago and New York, it carried in the year just passed 34,879,059 passengers and 42,874,315 tons of freight. To-day it is a model of efficiency, comfort and

Drawing of 1846 Type Erie Locomotive.

safety—a railroad of the first class, under a far-seeing and progressive management.

If we go back eighty years we will find this great institution in its earliest infancy, when ground was broken for its beginning at Deposit, N. Y. A substantial monument was erected there some years ago in order that one of the greatest events of the nineteenth century shall not be forgotten. This, eightieth anniversary, has lately been celebrated by appropriate ceremonies.

The New York and Erie railroad was chartered by the State of New York on April 24th, 1832, providing that the building of the road should be commenced at or near New York City. In spite of a tremendous opposition on the part of the so-called Erie Canal counties, fearful that the railroad would bring about their commercial and political ruin, the railroad company was organized in August, 1833, with Eleazer Lord as president. Although ground was first upturned in 1835 at Deposit, initiating the commencement of the enterprise, Piermont had been selected as its Eastern terminus and there the first rail was laid and the first spike driven home. The line was extended to Goshen in 1841 to Middletown in 1843; Port Jervis, in 1848; Binghamton, Owego and Elmira, in 1849; Hornellsville, in 1850, and Dunkirk, its then western terminus, in 1851. These ten years or more of construction represent a period of supreme efforts on the part of the railroad projectors, weary days and nights of



Old Erie Time Table, 1843.

anxiety in endeavors to secure financial assistance from the State Legislature and other sources. Defeats were many and in 1842, after a rigid investigation by an active Assembly committee, the enterprise went into bankruptcy, to be later brought forth to life and new energy. The "thrilling" ride between Piermont and Goshen, when this much of the system began operations, was preceded by listing the passenger, as if he were undertaking a sea voyage, and attaching a tag to his coat, which gave his name and destination. Thus equipped, like an express package or a member of some reception committee, he took his life in his hand and boarded the train.

The conductor ran ahead of the engine through the villages to keep the rails clear and with the assistance of the passengers, who always showed a willing disposition until the novelty wore off, loaded and unloaded the

Erie Mallet Articulated Compound "Matt. H. Shay" Built by the Baldwin Locomotive Works.

freight at stations, and did odds and ends of work as required. When the public tired of such occupation, on their part, turned this feature of the business into a grievance, the mixed trains were abandoned and regular trains of both classes were separately run.

Beginning with 1842 the Erie lays undisputed claim to running the first excursion train in the country; the first emigrant train, the first cattle train, the first sleeping car, crude as it then was: the first train, under telegraphic orders; making the first contract with the Government for carrying the mails, and when the line was finally completed to Dunkirk it was the longest railroad in the world, excepting the Russian Imperial line between Moscow and St. Petersburg. It was referred to everywhere as a "gigantic and stupendous enterprise," and it was—Chicago was a hamlet of hamlets and Fort Dearborn, its original name, was still on the map.

Imagine Daniel Webster and the president of the United States seated comfortably (?) in rocking chairs aboard a flat car, in the first train running into Dunkirk and later assisting at the celebration of joining Lake Erie and the Atlantic Ocean by helping to spill a barrel of salt water from the broad Atlantic into the shallow fresh water of Lake Erie.

In 1852 Jersey City was made the Eastern terminus and since that day the Erie has had as many ups and downs as a hotel elevator, culminating in a period of success and prosperity which signalize its present condition. There is really no success without disparaging adversity. Experience—bitter master as it is—is the foundation of every lasting and substantial good.

In 1861 the road, still known as the New York and Erie was reorganized and came forth anew as the Erie Railway Company. It has represented a battleground in struggles for control and for other purposes; has paralyzed Wall Street on some occasions, and rejuvenated the same neighborhood at other times. It has stood for honesty one day and dishonor the next, brought on by shameful manipulations. In 1878 it changed its name again, ashamed of its reputation, and bore the title of the New York, Lake Erie and Western until 1895. From dire misfortune and troubles it was then once more rescued to be finally sent on its way rejoicing under its present cognomen—the Erie Railroad Company. This name will stick to it till it dies, till the time when railroads are no more and the universe is transformed into a theatre of new thought and new enterprises.

Modern Type of Erie Locomotive 4-6-2, Built by the American Locomotive Company.

Some of us remember the old days when the Erie operated its trains over a track of six foot gauge; later the introduction of a third rail to accommodate some cars in the trains of the standard gauge, 4′ 8½″, and finally the change, completely, to the present-day gauge, all a matter of interesting history. From three primitive engines with which the first trains were handled down to the present-day equipment of 2,000 powerful machines, including the "Matt H. Shay," which can easily take care of 250 50-ton loaded cars at one time, is a long, long step: but from the first, improvement, increase and progress have been the order of the day, and this under the direction of twenty different presidents who have undertaken to manage the property through various periods of adversity and trouble to final success. Frederick D. Underwood now holds the reins and under his skillful management it is reaching the goal where possible dividends are in prospect. He drives with a careful hand, with a corps of able assistants about him which would indicate that the "genius of selection" is one of his most prominent characteristics.

Modern Erie 2-8-2 Engine, Built by the American Locomotive Company.

We will simply mention the acquisition of lines in New Jersey to complete a great suburban system; the New York, Pennsylvania & Ohio which gives a direct Cincinnati connection and the Chicago and Erie which lands passengers and freight in Chicago; but they have all combined to furnish the Erie system in the month of October, 1915, with more than $6,300,000 of business or at the rate of over $72,000,000 for the year, breaking the record for gross earnings in any given period in the history of the road. This has been accomplished by reduced grades, perfected alignment, first-class equipment; the employment of 39,000 men and the payment of $28,297,226 in wages.

When the Erie celebrated its eightieth anniversary it was an impressive occasion and worthy of more than ordinary mention, because it represented the practical beginning of our great railroad systems, which have brought about the present day marvels in the way of rapid and efficient transportation.

HIGH-SIDE STEEL HOPPER GONDOLA.

A very satisfactory form of steel hopper car has been built for the Bingham & Garfield Railway by the Pressed Steel Car Co. of Pittsburgh, Pa. These cars may be correctly called good examples of high-side steel hopper gondolas which are used, as this one is, for the carriage of copper ore from the mines to the smelter, over the heavy grades on that road. The design shown in our illustrations embodies pressed and rolled shapes distributed so as to obtain good service results, and on account of the large door area, the steep slope of the sheets and also the hoods over the center sills and cross bearers, the car is as nearly self-clearing as it can be made.

One of the principle features of the car is the design of the doors of the hopper. They are operated from one end of car by the well-known "creeping shaft device," patented by the company. This device is a simple, efficient, and positive and can be operated by an unskilled man. The doors are raised by operating heavy chains, winding on deep worms. When the doors are up, the shaft, which lies in a slot in the underframe, slides under the doors, thus forcing all the doors up flush with the floor regardless of variations in chain lengths, the doors resting directly on the shaft. They are thus safely and securely held in the closed position. In dumping, the mechanism allows the doors to drop suddenly with a shock to the car sufficient to help in dislodging the load. There are six doors in all, three on a side, and the slope of the ends permits the ore contained in the car to slip down and discharge when the doors are open.

The car is 29 ft. over the striking plates. The total length of the side doors, in the clear, is 12 ft. 1½ ins. The doors themselves are each 3 ft. 3⅝ ins. wide, and their width over the splice plates is just 10 ft. The inside width of the body is 9 ft. 11 ins, and the height from the top of the rail to the top of body is 10 ft. The brake

Interior of Gondola with Door Plates Closed.

mast stands 3 ft. 6¼ ins. below the top of the car, and it is 6 ft. 5⅜ ins. from rail to top of brake wheel. The king pins for the trucks, centre to centre, are 21 ft. 8 ins. apart.

The cubic contents when the ore is level with the top of the car is 1,200 cu. ft., but when the load has a 10-in. heap toward the centre, the contents become 1,380 cu. ft. The capacity as stencilled on the car is 120,000 lbs., which is 60 tons. The tare is given as 40,000 lbs. P. S. C. Wt. These letters stand for Pittsburgh Scale Car Weight so that the car without load weighs 20 tons. The dead weight of the body is 23,200 lbs. and that of the trucks together 17,000 lbs. The total is therefore actually 40,200 lbs. The maximum load is stated to be 132,000 lbs., and the ratio of paying freight to gross weight is 76.6 per cent. Roughly speaking, for every 100 lbs. of car and load, the revenue yielding weight of load is about 75 lbs.

The S. M. P. of the Bingham & Garfield Railway is Mr. F. G. Janney.

Bingham & Garfield, Steel High-Side Hopper Bottom Gondola, Built by the Pressed Steel Car Company.

Electrification on the Pennsylvania Railroad

The electrification of the suburban service of the Pennsylvania Railroad between Broad Street Station and Paoli is the first electrification undertaken by this company in the vicinity of Philadelphia, and its primary purpose is to increase the capacity of Broad Street Station and thus to relieve what congestion it can at that terminal. In addition to the through passenger train service accommodated at the station, there is an extensive suburban service extending over six different routes. The possibilities of electric traction were examined into by committees consisting of operating officials of the road and their analysis indicated that during rush hours the relief which would be secured by electrification would be equivalent to greatly increasing the station capacity. It is estimated that under electric operation there is a sufficient saving in operating costs as compared with steam to pay interest on the investment. Analysis of service conditions and cost estimates covering various electric systems led to the conclusion that one having a very high voltage overhead contact wire and one which eliminates moving machinery in substations for the supply of power, is the most suitable and also the most economical from the standpoint of both first and operating costs. In arriving at this conclusion, primary importance was attached to the feature of possible long distance operation over the entire divisions rather than to the requirements for present short suburban electric service. In this case 11,000 volt, single-phase 25-cycle power is supplied directly to the trains from the overhead catenary trolley system.

Power for traction purposes is purchased from the Philadelphia Electric Company. It is delivered to the railroad at a substation on the westerly bank of the Schuylkill River opposite the main generating station, the connection between the power house and the substation consists of armored submarine cables under the river. It is delivered at 13,200 volts, and is stepped up to 44,000 volts and, by means of duplicate single-phase overhead transmission circuits, then transmitted to the stepdown substations. While the present service is on one phase only of the power company's three-phase generating system, the plan is to supply the succeeding or future electrification power requirements from the remaining phases. Power at 25 cycles and 13,200 volts is transmitted from the electric power house to the Arsenal Bridge substation over four 350,000 c.m., 3-conductor submarine cables. On the west bank of the river the submarine cables are connected to paper-insulated, lead-covered cables, installed in clay ducts. From the Arsenal Bridge Substation there are four 44,000 volt single-phase transmission lines to the West Philadelphia Substation. The four transmission lines are carried on brackets on the side of the elevated structure between the Arsenal Bridge Substation and the West Philadelphia Substation. Beyond the West Philadelphia Substation the lines are carried on the catenary supporting structures. Along the right-of-way the lines are carried on both sides of the tracks. Horn gap switches for sectionalizing are installed on the roofs of the three substations and lightning arresters on the roofs of all substations.

View of Pennsylvania Railroad, Showing Catenary Suspension System as Applied to Curves.

One of the interesting features of the electrification is that the standard suburban steel coaches of the type used in the regular steam service have been used for the electric service without structural changes. This was made possible by the fact that the requirements for mounting electric apparatus on the cars had been thoroughly considered at the time when the steel car was introduced upon the railroad. The rolling stock consists of ninety-three

standard all-steel cars, eighty-two of which are passenger, nine are combined passanger and baggage, while two combined baggage and mail cars have been equipped. All cars are motor cars, as no trailers are to be operated in this service. The equipment of each car consists of two 225-horse-power, single phase, air blast-cooled, doubly fed motors, mounted on one truck, with automatic accelera-

Pennsylvania Railroad Yard, Showing Catenary Construction, Switches, Ground Signals and Catenary Supporting Towers.

tion, battery control equipment and automatic multiple unit electric air brake equipment. All of the main pieces of the electric apparatus are mounted on one end of the car and the air brake equipment is mounted at the other end. This gives an uneven weight distribution on the two trucks, approximately 60 per cent of the total car weight being on the driving wheels. The cars are designed for double-end operation on a 11,000-volt, 25-cycle overhead trolley line. Each car is equipped complete with two motors, having a 24-tooth pinion and a 55-tooth flexible gear. one 11,000-volt pantagraph trolley, one oil circuit breaker, one main transformer, one switch group complete, with reverser and a limit switch mounted on one end plate, one grid resistor, two master controllers, one motor generator set for supplying control energy, one control battery, three control junction boxes, four nine-point train line receptacles, one nine-point train line jumper, one valve magnet set for operating the trolley and "dead man's" feature, one line relay, one control cut-out switch, one combined blower and compressor motor with a Sirocco fan, and one set of details, including a control reservoir, control air details, battery switches, etc.

Current is collected from the overhead wire by the pantagraph trolley and is conducted to the main transformer through the line switch (oil circuit breaker). Various voltage taps are made on the secondary of the transformer and connections are made to these various taps in the proper sequence by means of unit switches. The motors, which are connected in series, are started and operated up to approximately 15 m. p. h. as repulsion motors, with the auxiliary or compensating field, the armature, and the main field in series. With these series connections, the armature is short-circuited through resistance. Resistance is also inserted in series with the motors on the first step and is cut out on the second step. The third step changes the connections to energize the auxiliary field from one portion of the transformer and the armature and main field, connected in series, from another portion of the transformer, thus affording doubly fed connections. The

armature short-circuit is removed when operating as doubly fed motors. Subsequent steps are obtained by increasing the motor voltages.

The master controller drum is energized from the motor generator set, in parallel with the battery, through a control plug, and moving the master controller handle to the right or to the left energizes the proper control circuit for forward or for reverse movement of the train. The closing of the unit switches is governed by a current limit switch. This limit has two settings, one for repulsion connections of the main motor and the other for doubly fed connection. The change in the limit setting is obtained by energizing a battery coil on the limit switch. All of the switches are interlocked through the No. 9 switch, so that no switches can close until the No. 9 switch is closed. A small knife-switch is placed in the control circuit of the No. 9 switch, and opening this switch cuts off the supply of current to the main motors. Ten control wires between cars are necessary to operate cars in trains, with one of these wires performing the dual function of the third operating wire, and the "trolley unlock" wire. Each motor has an hourly rating of 225-horse-power and a continuous rating of 200-horse-power when ventilated with 1,200 cu. ft. of air per minute. The armature is of standard construction, the commutator and the laminations being mounted on the spider, the former being undercut 1/16 in. The armature is wave-wound, cross-connected, and no resistance leads are used between the windings and the commutator. The field windings consist of two entirely independent sets of coils; one, the main field circuit, for producing the effective magnetic field; and the other an auxiliary or compensating winding which balances the armature reaction on the field and, in addition, has a neutralizing effect on the sparking voltage. The field consists of six poles, the coils being of copper bars suitably insulated, connected at the ends by straps.

The pantagraph is of especially light construction. The springs which raise it are designed to give flexibility to the framework, so that in operation a slight dragging of the trolley takes place, resulting in its following the wire much closer than with a rigid framework. In addition, the shoe is spring mounted on the framework. The trolley is provided with four insulators suitable for 11,000-volt service, and the whole mechanism is mounted on a base provided with insulators similar to those of the trolley, thus providing double insulation. The trolley is lowered and unlocked by air at 70-lbs. pressure. A small hand pump is provided for unlocking the trolley when no air pressure is available. The "Safety First" principle has been carried out in the provision of a grounding device of novel design. Steps for mounting to the roof are provided at one corner of the car only and a lever is placed on the roof at this corner. When one climbs to the top of the car, this lever is thrown up, thus locking the trolley in the down position and grounding the entire framework. The line switch is air-operated and is closed by energizing a control circuit from the master controller plug. A handle is provided for manually closing the switch when compressed air is not available. Overload protection is provided by a series coil, into which a plunger is pulled, this plunger carrying a disc contact which is connected in series with the operating valve magnet. When tripped, the plunger is latched and must be reset by energizing the reset coil from the master controller.

The limit switch is of novel construction. The current coil, which is connected in the auxiliary field circuit of the motor, surrounds a plunger which carries the control contact disc. The two settings of the limit switch are obtained by changing the weight of this plunger. This is done by lifting a weight from the plunger by means of a battery coil mounted above the current coil. The resistor consists of two frames of 14-in. cast iron grids mounted in angle iron end frames, the construction of which is standard, except that the usual copper washers between connecting grids have been omitted. The master controllers are of the single handle type. Two plug receptacles are embodied in this controller and a single plug is attached to the handle by a chain, placing the plug in the "cut-out" receptacle completes the circuit, energizing the line switch valve magnet, and also connects the controller drum to the battery positive wire. Placing the plug in the "reset" receptacle connects the reset wire to the battery positive train line wire. Nine controller positions are provided; an emergency or "dead man's" position in the center, and an "off," first, second and third running positions for both forward and reverse movements. The controller drum is spring returned, and if released, will return to the middle or emergency position. In this position, the control is cut off and a valve magnet is energized which releases air from and operates a brake pipe relay, thus applying the emergency brake. This emergency circuit is local for each car. Each controller also has two push button switches for unlocking or lowering the trolley. To unlock the trolley, the control plug must be in the "cut-out" receptacle, but the trolley may be lowered without the plug being in place. Each controller is mounted at the right hand side of the vestibule, together with the motorman's brake valve, the signal whistle and magnet, and the cab heating equipment. When not being used the end vestibule door is swung back to cover all this apparatus. Control energy is obtained from a motor generator operating in parallel with a battery. The motor is of the single phase induction type, with a starting winding that is cut-out of circuit when the motor has attained speed. The generator is wound for three volts at no load and 32 volts at full load. The storage battery is a 20 ampere hour, 20-cell type.

The air brake equipment of each car consists of two main reservoirs with radiating pipes, one safety valve on the main reservoirs, one compressor governor, two motorman's brake valves, with feed valves and reduction limiting valves, two combined equalizing and reduction limiting reservoirs, one emergency or quick recharge reservoir, one auxiliary and one service reservoir, one universal valve, one main reservoir bypass and limiting valve, one double check valve, one brake cylinder, one automatic slack adjuster, two duplex air gauges, four seven-point train line receptacles, one seven-point train line jumper, one brake pipe, one main reservoir pipe, and one set of accessories, which includes cut-out cocks, air strainers, hose, dirt collectors, switches, etc. This equipment is designed so that it may be used either in steam or electric service, and differs from the ordinary pneumatic brake in that the brake pipe reduction is made on each car by means of electric control, instead of being made entirely with the engineer's brake valve. The addition of electric control to the pneumatic brake does not change its function in any way, but shortens the time required to get the brakes applied on all cars.

The main reservoir pressure carried is 100 lbs. and the brake pipe pressure is 70 lbs. To permit the operation of these equipments in steam service, where the brake pipe pressure is 110 lbs., without making adjustment, a main reservoir bypass and limiting valve is employed. By its use the same cylinder pressure is secured in making an emergency application in either steam or electric service, although the operation of the universal valve is the same for either. In steam operation, the pipe line which is

used as a main reservoir line in electric service is used as a signal line.

Following the heavy sleet storm of March, 1914, the company put certain portions of their telephone and telegraph wires underground, and this has now been done throughout the electrified zone. Along the main line this underground conduit consists of six single ducts, 3-in. bore; part is clay conduit and part of bituminized fibre. The conduit bank is protected with concrete on all sides. There are concrete manholes every 400 ft. or less. In addition to the usual telephone facilities between substations and between the electric power director and the train dispatchers, there are permanent telephone boxes located at every signal bridge, approximately half a mile apart, throughout the electrified zone. Prompt, reliable communication by telephone is possible between any part of the whole system.

ENERGY, KINETIC AND POTENTIAL

Work in the mathematical sense is pressure acting through distance, and this, when measured by our common units, a foot of distance and a pound weight, is usually stated as foot-pounds. Energy is simply capacity for performing work. Energy is, however, of two kinds: kinetic, or moving, active, energy, as when work is performed; and potential energy, which is passive, and not at the time performing any work, though capable of it.

One very common form of potential energy with which railroad men are familiar is the potential energy of position. This is exemplified when a winch draws up the hammer of a pile-driver to the top of the guides, and lets it hang there. The winch stops and a detent holds the weight. The winch supplied energy in the kinetic form, and the weight absorbed it in its upward movement. As long as the detent holds, the weight remains inert and does no work. When the workman "lets go," the hammer slips down the guides, delivers its blow, and the pile goes down under the impact. When at the top of the guides, the hammer had the potential energy of position with reference to the pile. This energy, in the passive form, was dependent on previously expended kinetic energy as when the winch raised the weight, and the relation of equality between the two always exists, when the friction due to motion is allowed for. In other words, if the winch gave out 100 foot-pounds of energy, after friction had been deducted, to raise the weight, the weight would give out 100 foot-pounds of energy when it fell, if its friction along the guides was added in.

The spring of a clock, when wound up, has the potential energy of molecular displacement, owing to the forced rearrangement of its particles, as the spring becomes distorted in the process of winding. In the case of the pile-driver, the raising of the weight was slow, in comparison to the fall, and in the case of the clock spring, a few moments occupied in winding, would carry the hands round slowly, hour after hour, as the escapement retarded the rapid change of the potential energy into the kinetic form. The potential energy is, in a sense, a sort of absorption of previous motion, through distance. If the pendulum was not set a-swing, the potential energy of molecular displacement could not later assume the kinetic form.

Now that the use of the "Silent Power," by which we mean electricity, has come into vogue, both for propelling trains, signaling and lighting, we come face to face with a very evident transformation of energy. No one knows exactly what electricity is, but we judge of it by the effects it produces, and what we see it do. Sylvanus Thompson inclines to the belief that the so-called positive and negative forms of electricity are really nothing more nor less than excess or defect in the amount of electricity present in any body. The so-called negative charge appears to be an excess and the so-called positive charge is a deficiency of electricity. He strengthens this idea by the statement that the rate of dissipation of a charge is found to be greater for negative than it is for positive electricity. Furthermore, the law of loss is the exact counterpart of the law of the loss of heat. The hotter a body is, the higher rate of loss it experiences, when compared with the rate of loss of a cooler body.

This brings us to the contemplation of the fact that a wire carrying current, produces an atmosphere about it which is different from the atmosphere when the wire is not electrified. This has lead many people to conclude that electricity resides on the surface of a body and not in its interior. If the changed atmosphere theory is true, it is not the air which is affected, but the ether which pervades all space. The particles of ether are disturbed or their positions have been altered in some way, by being thrown into that state by the action which we call electricity. The extent of the disturbed ether, constitutes the electric "field." It varies according to circumstances, but where an electric state is produced, there is more or less field, but a field is always present under the circumstances.

Electricity is usually generated by the expenditure of mechanical energy, as when a steam engine turns a dynamo. When this force is introduced into a storage battery, it separates the chemical constituents of the battery fluid, and the work of pushing the molecules of the elements apart, endows the storage battery with what is known as the potential energy of chemical separation. These disunited elements are ready, one might almost say eager, to flow together again and give up, in the kinetic or active form of energy used to separate them, when appropriate means have been supplied, such as the uniting of a connecting wire or the closing of a switch. The effect of electrifying a coil of wire tends to produce tension in the ether surrounding each separate wire in the coil, and this potential energy is released in the kinetic form only by a connection being made, and work is done, in moving a relay armature or in drawing up the iron core of a solenoid.

When looking at the heaped pile of coal on the tender of a modern locomotive, one does not, at first, realize that it possesses the potential energy of chemical separation. Long before the time when man appeared on the earth, gigantic forests grew up and flourished in abundance, and over vast areas. It is a property of plant life, through the agency of its leaves and under the compelling power of the sun, to separate from the carbonic acid of the air, the oxygen which forms one of its constituents. Thus amid the warm rays of the sun, these plants of long ago, appropriated the carbon and incorporated it within their growing structures, and set free the oxygen. In doing this, it effected a chemical separation: and the subsequent overthrow of the forests and their preservation in the depths of the earth. There they remained, unburned and unable to rot, because no oxygen could reach the buried mass, and the temperature condition was absent.

Coal, therefore, as we see it, roughly speaking, is carbon divorced from oxygen which it stands ready to embrace, when appropriate conditions start and maintain the process. The chemical separation effected ages ago is obliterated and union is effected, in the glowing, burning mass and the white-hot flame in the fire box of a locomotive, as it hauls the flyer through the luxuriant foliage of the Mohawk Valley or rushes with its train over the alkaline deserts of the West. The collected

and stored up carbon, as it lies there on the tender, has potential energy in enormous quantity. An hour's run of the iron horse may use up years of slow and patient chemical disintegration in the forest of an age long past.

Tyndall tells us that the atomic forces set free, as when the carbon "burms" or re-combines with oxygen, are well-nigh irresitible. As an exampie he takes a pound of iron heated from 0 to 100 degs. Centigrade. It expands one-eight hundredth of its volume at zero. This might most easily escape the closest scrutiny by the human eye, yet to produce so slight a sensible effect, would require a force capable of raising 8 tons 1 ft. high. The force of gravity almost vanishes in comparison with these molecular energies, and as if to make clear to our minds this partially understood but important truth the great physicist says: "I have seen the wild stone-avalanches of the Alps, which smoke and thunder down the declivities, with a vehemence almost sufficient to stun the observed. I have also seen snow-flakes descending so softly as not to hurt the frogile spangles of which they were composed; yet to produce, from aqueous vapor, a quantity, which a child could carry, of that tender material, demands an exertion of energy competent to gather up the the shattered blocks of the largest stone-avalanche I have ever seen, and pitch them to twice the height from which they fell."

PULVERIZED COAL BURNING ON SHIPS

The Pacific Coast Steamship Company, of Seattle, Wash., intend testing the possibilities of using pulverized coal as fuel for marine boilers, says a recent Commerce Report. The cheapest grades of coal can be used in the pulverized form, and this system, if successful, will be cheaper than the present coal-burning methods and as well being a serious competitor of oil.

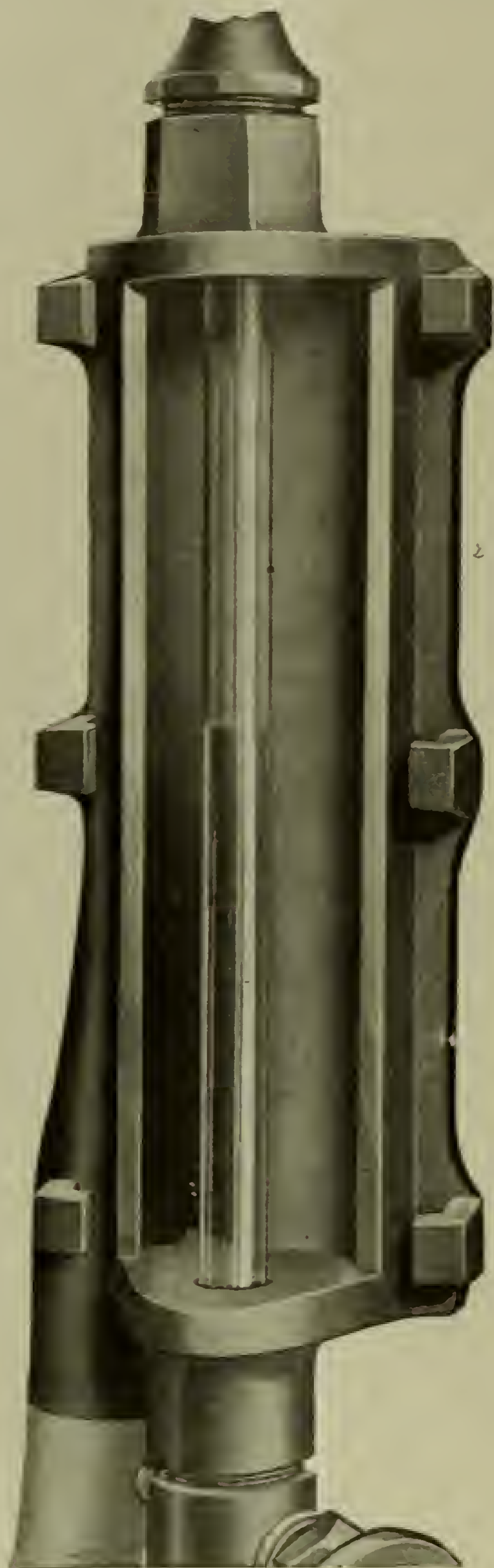
It is stated that where railroads have used this system the records show that the pulverized coal produces more steam than coal in its ordinary form and that smoke is eliminated. Dust and ashes are carried off in the exhaust and gives a considerable saving in the quantity of coal consumed, as complete consumption takes place. As in the case of oil fuel, a strong artificial draft is necessary, while grates, ash pans, smoke-box netting, spark hoppers, firing tools, are eliminated. The pulverized coal is fed into a blower by a gravity conveyer and the blower drives it into the fire-box, where combustion takes place similar to that of oil.

WATER GAUGE PROTECTOR

A shattered water gauge glass is a possibility in an engine cab. When an unprotected water gauge does break the ensuing damage is usually out of proportion to the accident. We do not say that this is a device which will prevent the water gauge glass from breaking. So long as the glass water gauge is with us, just so long will we have breaks. An efficient protector is a device which, in the event of a broken gauge glass will probably protect the enginemen from injury, which often, at critical moments, results in more trouble than one might expect.

Our illustrations show that this device consists of a heavy cast bronze two-piece casing, held together by interlocking flanges. The casing completely encloses the gauge. Openings at the sides, protected by two thicknesses of 3/16 in. glass, permit clear vision and afford a good sight of the gauge. A slot running lengthwise of the front of the casing and similarly fitted with a double thickness of glass gives a bright illumination in the casing. An opening at the bottom of the back of the casing suitably piped, carries steam, hot water and even broken glass, away. Apart from the value of the device it has a humanitarian aspect in its work of protecting the men in the cab from injury.

In the event of breakage there is very little delay in the operation of the train beyond the few minutes necessary to replace the gauge glass. This replacement is easily accomplished. The casing and safety outlet protect the



Glass Water Gauge Protector.

man while he closes the connections to the gauge. The front of the casing is slipped off, a new gauge tube is inserted, the front replaced, gauge connections opened, and the train may proceed.

A faulty or misleading reading of the gauge is practically impossible with this plan of rendering the water level always clear and distinct. No special form of glass is needed for renewal after breakage, and a reserve supply of glasses may be carried if desired.

The makers of this improved water gauge protector have been arranging to place a test sample in the hands of master mechanics and of superintendents of motive power with a view of having the device tested.

Practical Suggestions from Railway Shop Men

TESTER FOR COACH GAS TANKS

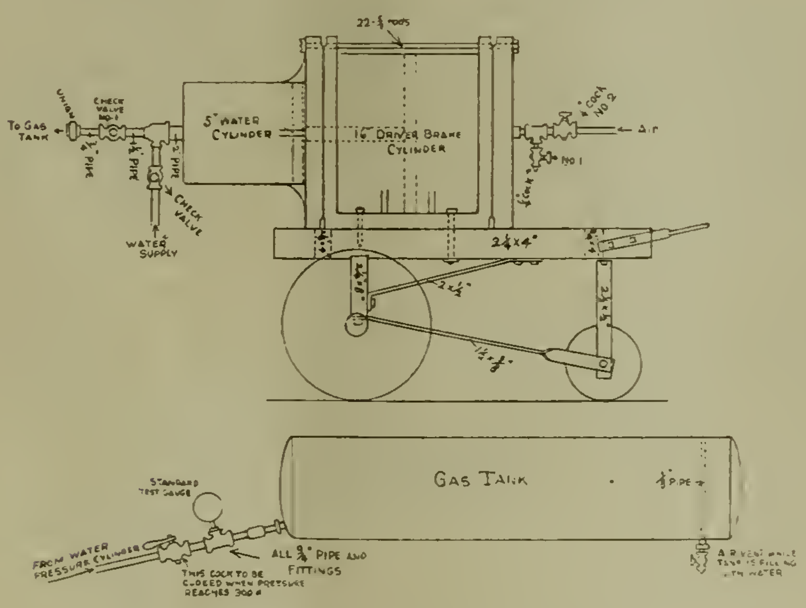
By T. M. W. C.

I am sending you a sketch of a device used in our shop for testing gas tanks on cars used in our passenger service. It is not a new device, having been in use here for three or four years. I would be pleased to have you give it space in the RAILWAY MASTER MECHANIC, as it may be found useful to some one in railway work. We are required to give our gas tanks a periodical test, using hydraulic pressure, as we have no means of obtaining gas for this purpose.

The device was made from a 16 ins. driver brake cylinder with a 5 x 7 ins. water cylinder attached as shown. This cylinder forms the front head of the air cylinder, the piston heads of the two cylinders are connected so they move together. The device is mounted on a small three-wheel truck, of convenient height to attach to gas tank, without having to remove tank from car, and we have found this a great time saver.

The method of testing is to attach the device to the gas tank and apply the water. We drill a ⅜ in. hole in the bottom of the tank and screw in a fitting which has a ⅛ in. pipe attached to it. This pipe reaches close to top of tank and allows air to escape. While the tank is filling, we get from 90 lbs. to 95 lbs. of water pressure at a service application.

When the tank is completely filled with water we make an application of air, and the pressure in tank is usually forced up to 300 lbs. per sq. in. on the first application, but in case we do not get the full service water pressure,



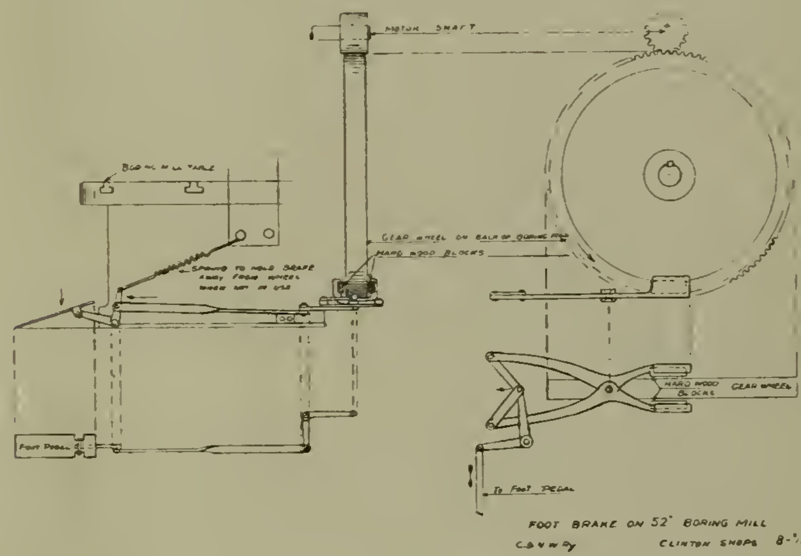
Apparatus for Testing Gas Tanks.

we make another application of air. To do this the water pressure is held in tank by a check-valve, No. 1. The small ¼ in. cock, No. 2, at the rear of the 16 in. cylinder is closed and the cock, No. 1, is opened to permit air to escape from the cylinder. The water forces the piston in the water cylinder back, which in turn forces piston in air cylinder back. Both are connected together. Another application of air is then made which will easily give the required 300 lbs. pressure. This pressure is maintained for 15 minutes, and if no leaks develop, the test is complete, the vent pipe is then removed, water is drawn off and the hole in the bottom of the tank is closed with a ⅜ in. plug brazed in.

BORING MILL BRAKE

By Chas. Markel, Shop Foreman, Clinton, C. & N. W. Ry.

The drawing I am sending shows a foot brake which was designed at the Clinton shops of the Chicago & North-Western Railway by Mr. W. Shaw, machinist, and is applied to 51-in. boring mill, which is electrically driven, and the results obtained are very satisfactory, and the device is well liked by the men who operate the machine.



Foot Brake for Boring Mill.

The advantages of a brake on a boring mill are many, especially when running the table on high speed, as the weight of table and work bolted to it will make it revolve some time after shutting off the power. This is all lost time. Another advantage is safety in case the mill is required to stop quickly, which happens very often. The sketch is very plain and easy to understand. The brake can be applied to any boring mill with very little expense. It is levered to such an extent that very light pressure of foot on treadle will bring the table to rest, and we might almost compare it to an emergency stop made on a locomotive. It certainly saves time and trouble and is a sort of safety appliance and it is thus in line with the spirit of the times.

Armstrong Bros. Tool Co., Chicago, announce that they were awarded the grand prize for tool holders at the Panama-Pacific Exposition at San Francisco, this being the first grand prize ever awarded for an exhibit of tool holders at any international exposition, and the only grand prize awarded exclusively and specifically to an exhibit of tool holders independently of other products. They were also awarded a medal of honor on other Armstrong products exhibited, including ratchets, drop forged wrenches, clamps, lathe-dogs, etc.

CARE OF INJECTORS AND LUBRICATORS

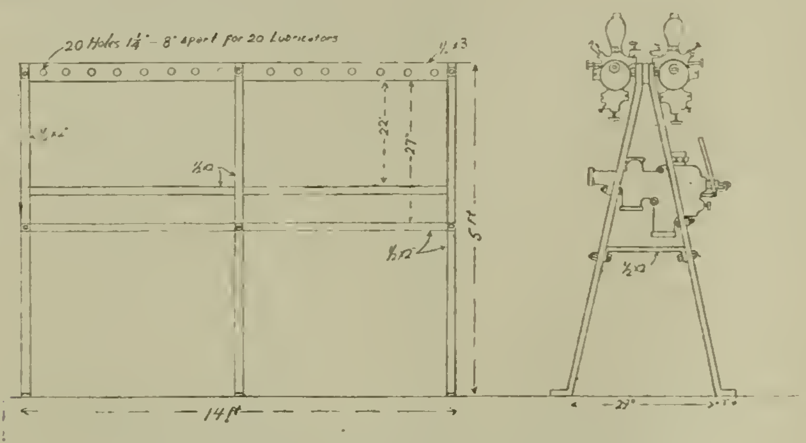
By J. A. Elliott, Air Brake Fitting Foreman, Ill. Cen. Ry.

Enclosed please find sketch of injector and lubricator rack which I am sure will be appreciated by a good many of your readers. When injectors and lubricators are removed from engine for repairs they are, as a general rule, brought to the injector room and laid in a pile on the floor, or on the bench or probably piled under the bench until they can be worked on.

After they have been overhauled they are again piled on the floor or bench awaiting their application on an engine.

The result of this kind of handling is very often broken and bent valve, stems and levers, broken glasses and ruined steam joints and, of course, the injector room never does look ship-shape.

To overcome this trouble I designed and built the device shown in the accompanying sketch, which is very simple in construction.



Rack for Holding Injectors and Lubricators.

The injectors set on the two horizontal bars and the lubricators are bolted with the lubricator stud nut to the top horizontal bar.

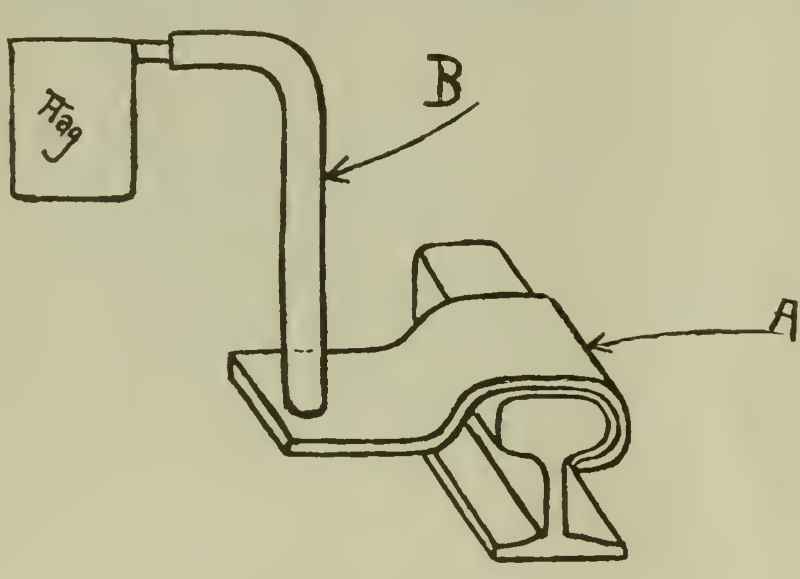
We find this a very handy arrangement, as it takes but a minute to apply or remove either injector or lubricator. If the dimensions given in the sketch are followed, this rack is suitable for all classes of injectors from size No. 7 to No. 11 and all classes of lubricators, bull's eye and tubular glass lubricators. The capacity of this rack is twenty lubricators and thirty-two injectors.

CAR REPAIRERS' FLAG HOLDER

By J. A. Jesson.

I enclose drawings of some very handy devices that have been in use at the Corbin, Ky., shops of the Louisville and Nashville Railway for quite a while.

Fig. 1 is a car repairer's flag holder. It consists of a 3/8 x 4 in. piece of flat bar iron A formed to hook over the rail, as shown. It is tapped for the 1-in. pipe B and is



Car Repairers' Protecting Flag Holder.

bent at right angles. The flag staff is wood and is inserted in the open end of the pipe. The combined weight of the pipe and plate holds it securely in position. If it is desired to keep it all level a block of wood or a stone under the plate can be used, or the plate can have an offset in it so as to let it rest on the tie.

TABLE OF BOSSES

By W. H. Wolfgang, Toledo, Ohio.

The accompanying table is very convenient for the drawing office standardization sheets for square and hexagon nuts and bolt heads. This is to standardize bosses when designing castings where bosses are used. It is usually found no two men will have the same dimensions when designing.

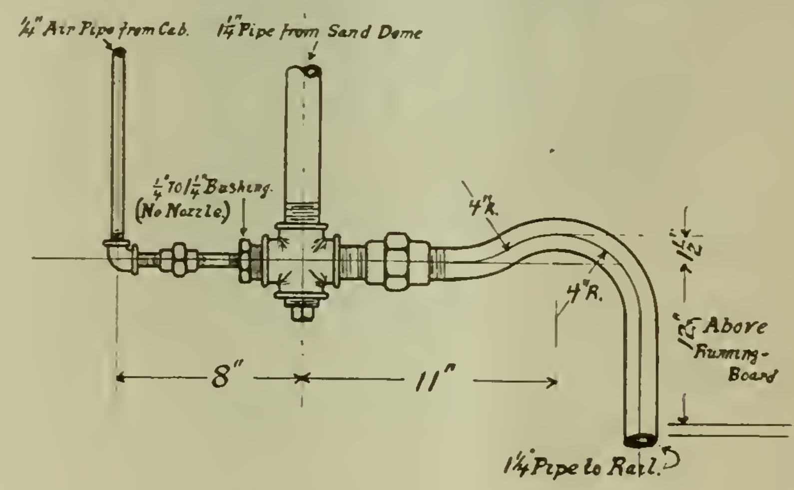
Table of bosses for square and hexagon nuts and bolt heads:

	—Diameter "A" of Boss—		
Size of Bolt.	Hexagon.	Square.	"R."
1/4	5/8	3/4	1/32
5/16	3/4	7/8	1/32
3/8	15/16	1 1/16	1/32
7/16	1 1/8	1 1/4	1/32
1/2	1 3/16	1 3/8	1/32
9/16	1 1/4	1 1/2	1/32
5/8	1 3/8	1 5/8	1/32
3/4	1 9/16	1 7/8	1/32
7/8	1 3/4	2 1/4	1/32
1	2	2 1/2	1/16
1 1/8	2 3/8	2 13/16	1/16
1 1/4	2 9/16	3	1/16
1 3/8	2 3/4	3 3/8	1/16
1 1/2	3	3 5/8	1/16
1 5/8	3 1/4	3 7/8	3/32
1 3/4	3 1/2	4 1/8	3/32
1 7/8	3 5/8	4 3/8	3/32
2	3 7/8	4 3/4	3/32
2 1/4	4 3/8	5 3/8	3/32
2 1/2	4 7/8	5 7/8	3/32
2 3/4	5 1/4	6 3/8	3/32
3	5 7/8	7	3/32
3 1/4	6 1/4	7 1/2	1/8
3 1/2	6 3/4	8 1/8	1/8
3 3/4	7 1/8	7 5/8	1/8
4	7 1/2	8	1/8

TRACK SANDER

By A. H. Wiltshire, Draughtsman, A. G. S. R. R.

Our illustration shows a track sander that is simple, easily made, and gives perfect satisfaction. The pipes are run from the sand dome to the "cross" and are kept full of sand by gravity, so that when the engineer's valve



Piping for Track Sander.

is opened a stream of sand is blown over the hump in the delivery pipe. The amount of sand is controlled by the extent of the valve opening. The 1/4-in. air pipe from the cab runs to a tee on the top of boiler, where it divides, giving an equal pressure to both blast pipes and causing a uniform flow of sand to both sides of the engine. The plug at the bottom of "cross" is easily removed to clean out wet sand or gravel. The valve rigging in the dome should be left open or removed entirely.

Don't tell what you are going to do—Do it!

Personal Items for Railroad Men

W. E. Grove has recently been appointed assistant car inspector of the Philadelphia & Reading R. R. Company.

E. F. Lemay, recently appointed general foreman of the Central of Georgia Ry. at Albany, Ga., succeeds there A. C. Soule.

A. S. Brown, recently appointed storekeeper of the Salt Lake & Ogden Ry. at Salt Lake City, succeeds there W. H. Bliss, resigned.

E. D. Morrison has recently been appointed general foreman of the car department of the Baltimore & Ohio R. R. at Cumbo, W. Va.

J. S. Pritchard, recently appointed supervisor of materials of the New York Central Ry. at Cleveland, Ohio, succeeds there W. J. Trey.

G. H. Hedge has recently been appointed general master mechanic of the Canadian Northern Ry. with headquarters at Winnipeg, Man.

R. L. Doolittle, recently appointed general foreman of round house of the Central of Georgia at Macon, Ga., succeeds there H. L. Watson.

H. D. Pollard, recently elected president of the Wrightsville & Tennille R. R. Company at Tennille, Ga., succeeds Judge A. F. Daley, deceased.

C. J. Quantic has recently been appointed master mechanic of the Pacific Division of the Canadian Northern with headquarters at Port Mann, B. C.

F. J. Yonkers has recently been appointed road foreman of equipment for the Columbia Division of the Chicago, Rock Island & Pacific at Goodland, Kan.

G. A. Hartline, recently appointed master blacksmith of the New York Central at Collinwood, Ohio, succeeds there E. T. Haskins, transferred to Elkhart, Ind.

H. A. English, recently appointed master mechanic of the Central Division of the Canadian Northern Ry. at Winnipeg, Man., succeeds there G. H. Hedge, promoted.

Wesley Fuller, recently appointed road foreman of engines of the Lehigh & New England Railroad Company, succeeds, in that work, John McMullen, assigned to other duties.

G. F. Shull, recently appointed master mechanic of the Carolina, Clinchfield & Ohio Ry. at Erwin, Tenn., has been serving at that point in the capacity of acting master mechanic.

T. E. Hessenbruch has recently been appointed fuel and locomotive inspector of the Philadelphia & Reading, and H. W. Cathcart has been appointed assistant fuel and locomotive inspector.

J. W. Tenney has recently been appointed road foreman of equipment for the Missouri Division west of Eldon, Ia., of the Chicago, Rock Island & Pacific at Trenton, Mo., succeeding M. J. McDonald, promoted.

L. C. Ord, assistant works manager, Angus Car Shops, Canadian Pacific Ry., has been appointed lieutenant in No. 1 Overseas' Battery of the Siege Artillery, Canadian Expeditionary Force, and has been granted leave of absence for active service.

E. B. Van Patten has recently been appointed Southwestern sales representative for the Acme Supply Company, of Chicago, Ill. Mr. Van Patten's experience covers representation of railway supply firms in this territory for a number of years past.

J. J. McNeil, recently appointed supervisor of locomotive operation for the Erie at Youngstown, Ohio, succeeding D. J. Maddon, promoted, leaves the position of road foreman of engines at Cleveland, Ohio. Joseph Bluetge has been appointed road foreman of engines at Cleveland, Ohio, to succeed Mr. McNeil.

H. S. Allen, recently appointed foreman of the Norfolk & Western at Petersburg, Va., entered the service of that road in 1912 as machinist at Chenandoah, Va., and in 1913 was transferred to Crewe, Va. In 1914 he was made machine foreman at Petersburg, which position he held until his appointment as foreman.

W. L. Hazzard has been recently appointed supervisor of piece-work for the motive-power department of the New York Central Railroad, and Edward J. Thill has been appointed supervisor of piece-work for the rolling-stock department. These supervisors of piece-work will hold joint offices in the Grand Central Terminal, New York City.

P. Coniff, recently appointed special inspector of the mechanical department of the Baltimore & Ohio, is succeeded as superintendent of shops at Mount Claire, Baltimore, Md., by E. J. Brennan. E. J. Brennan, recently appointed superintendent of shops of the Baltimore & Ohio at Glenwood, Pittsburgh, Pa., succeeds P. Coniff, appointed to other work.

A. B. Colville, recently appointed general foreman of the Spokane, Portland and Seattle Terminal at Portland, Ore., entered the service of the Great Northern Ry. in 1899 serving as machinist, rising through the position of gang and outside foreman to machine and shop foreman during his work there. Mr. Colville succeeds in his new work E. L. Croncrite.

G. H. Abendschein, recently appointed storekeeper at Glasgow, Mont., for the Great Northern R. R., entered the service of that company at Breckenridge, Minn., in 1904 as call boy and entered the stores department in 1906, holding minor positions until in 1911 he was appointed storekeeper at Casselton, N. D., and transferred in 1912 to Judith Gap, Mont., and now appointed at Glasgow.

J. J. McCabe, recently made trainmaster and road foreman of engines on the Shenandoah Division of the Baltimore & Ohio Railroad, entered the employ of that road in 1880, in the motive-power department at Sandy Hook, Md. In 1883 he was promoted to fireman on the Shenandoah Division, and in 1887 to engineer. In 1890 he was given a passenger run on the Baltimore Division, and in 1895 was made passenger engineer in the Blue Line service on the Philadelphia Division. In 1903 he was made assistant trainmaster on the Baltimore Division, and he has held this position until the announcement of his recent appointment. Mr. McCabe succeeds in his new work F. H. Howser, who has been transferred to freight engineer on the Baltimore Division.

Mr. N. S. Reeder has been elected vice-president of the Pressed Steel Car Company, effective December 1, 1915, with headquarters at New York City. Mr. J. B. Rider has been elected vice-president, with headquarters at Pittsburgh, and will continue to perform the duties of

general manager in charge of operations. Mr. J. F. MacNulty, formerly general sales manager, has been elected second vice-president, with headquarters at New York City. Mr. C. E. Postlethwaite, formerly manager of sales, Central District, Pittsburgh, has been appointed general sales manager of the Pressed Steel Car Company and the Wsetern Steel Car and Foundry Company, with headquarters at New York City. Mr. H. P. Hoffstot has been appointed assistant sales manager, Central District, with headquarters at Pittsburgh.

BOOK REVIEW

Principles of Locomotive Operation and Train Control, by A. J. Wood, M. E., Associate Professor of Mechanical Engineering, Pennsylvania State College. Published by the McGraw-Hill Book Co., New York, 1915. Price, $3.00.

The work before us is intended to present recent developments in locomotive performance and it includes a study of the air brake. The book is divided into sixteen chapters and contains, with index 271 pages. The consideration of the whole subject opens with some observations on general principles, followed by the standard classification system of locomotives, according to their types.

A very interesting and instructive chapter (viz, III) is voted to tractive effort. The forces which operate in moving a locomotive are put before the reader very clearly and exceedingly briefly. Thus the valuable information on this subject is in compact form which loses nothing by its condensation. Chapter IV deals with the acceleration of trains, and the formulas to use in solving various problems are given. Train resistance follows in logical order, and under this head are considered machine friction, and the resistance encountered on curves and grades and in cold weather is handled very fully. Chapter VI takes up new graphical methods applied to locomotive performance. VIII is on dynamometer tests. IX deals with the theory and practice of brake service. IX is on combustion and fuel economy. X, steam, its formation and action. XI, superheated steam. XII, locomotive ratios. XIII, locomotive testing. XIV, counterbalancing. XV, electrification of steam railroads, and XVI, materials of construction. This book is a useful and valuable addition to the literature of the subject, and is written from the practical every-day standpoint.